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# **The virtualMe: A Knowledge acquisition framework**

A thesis presented in partial fulfilment of the requirements  
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## Abstract

Throughout life, we continuously accumulate data, information and knowledge. The ability to recall much of this accumulated knowledge commonly deteriorates with time, though some forms part of what is referred to as tacit knowledge. In the context of education, students access and interact with a teacher's knowledge in order to create their own, and may have their own data, information and knowledge that could be added to teacher's knowledge for everyone's benefit. The realization that students can contribute to enhancing personal knowledge is an important cornerstone in developing a mentor (teacher, tutor and facilitator) focused knowledge system.

The research presented in this thesis discusses an integrated framework that manages an individual's personal data, information and knowledge and enables it to be enhanced by others, in the context of a blended teaching and learning environment. Existing related models, structures, systems and current practices are discussed.

The core outcomes of this thesis include:

- the *virtualMe* framework that can be utilized when developing Web based teaching and learning systems;
- the *sniplet* content model that can be used as the basis for sharing information and knowledge;
- an annotation framework used to manage knowledge acquisition; and
- a multimedia object (MMO) model that:
  - allows for related media artefacts to be intuitively grouped in a logical collection;
  - includes a meta-data schema that encompasses other meta-data structures, and manages context and referencing; and



- includes a model allowing component parts to be re-aggregated if they are separated.

The *virtualMe* framework provides the ability to retain context while transferring the content from one person to another and from one place to another. The framework retains the content's original context and then allows the receiver to customise the content and metadata so that the content becomes that person's knowledge. A mechanism has been created for such contextual transfer of content (context retained by the metadata).

## **Keywords:**

Knowledge acquisition, knowledge management, knowledge technologies, computer supported cooperative work, snippet, Media Vocabulary Markup Language, MVML, multimedia object, MMO, virtualMe

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## **Ethical approval**

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# 1 Introduction

For an educator in information technology, there are many research opportunities where both the teaching and learning, and information technology can be combined. The focus of the research presented in this thesis began with the observation that in an enhanced teaching and learning environment, in which face-to-face (f2f) and electronic support is provided, students can make a significant contribution to the content delivered, particularly where the student may have first-hand experience. For many reasons however, often this is not the case. For example, a student may be uncomfortable with sharing in a group environment; the opportunity may be lost due to time constraints; or the student may be working independently with the content.

To cite two specific cases that occurred prior to the formal part of this research being undertaken, *coding systems* were being discussed with the class. One of the students was involved in the banking industry and was able to relate the coding systems content to that used on cheques and credit cards. In a second instance, a student formerly a medical doctor was able to relate personal identification systems to the National Master Patient Index (NZHIS, 2003), which linked the ethical issue of a national identifier with the practical application of such a number.

Bourner (2002) suggested that research can follow from an awareness of a problem worth solving, and proposed a framework in which research could be conducted. This research follows a five stage methodology based on Bourner (2002), which includes: investigating the problem, reviewing the field of study, theory building, theory testing, and finally reflection and integration.

## **1.1 Developing an overall framework**

In an f2f environment, content is typically created by the instructor and then delivered to the students in a lecture mode. This content knowledge may be collected in a variety of ways, for example, by reading (books, papers, journals), listening (radio, television), discussing (conversations, classes), and experiencing (walking, working, living!).

Teaching content is often updated through further research undertaken by the lecturer, however students too can provide feedback to improve the quality of the content. If students wish to inform the lecturer of content that is new, or could be enhanced, or needs revision, in a traditional setting this is conveyed verbally, and unfortunately, is often lost.

With the use of electronic communication, other methods are available to inform the lecturer that content could be improved or needs revision. Email is a common way for lecturers and students to communicate, and many courses use bulletin boards or list servers to enable wider discussion and comments between the lecturer and students, or between students. Unfortunately, the comments are not directly attached to the content, that is, they are out of context, and require a search through the affected content before amendments can be made.

The difficulty of capturing this knowledge in context provides many challenges, in both business and educational settings. The World Wide Web provides a potential technology platform that is accessible in and out of the classroom with the capability to store and disseminate content, and an ability to annotate content directly.

Awareness of the problem emerged as the capabilities of managing and delivering content electronically evolved. During the 1980s and early 1990s, electronic resources were typically static in nature with a minimum amount of interactivity, and were stand-alone. Content was created in early word processors with limited graphic capabilities. With the development of the

Web browser, Mosaic, in 1993, new ways of presenting and managing content emerged. By 2000 the technology had matured sufficiently to allow content to be presented reliably in Web pages with images, and there was sufficient institutional and student connectedness to make this feasible. By 2002 the capability to provide database driven Web sites opened up many possibilities, and it was in these years that the problem addressed by this thesis developed.

A suitable environment was required in order to conduct this research. Existing systems were rapidly emerging, evolving and changing as more and more uses were found for the World Wide Web. Commercial course management systems (CMS) emerged, such as WebCT (Wikipedia, 2008b; Blackboard, 2005) and Blackboard (2008b) and underwent rapid evolution as innovation drove Web application development. In both these cases the systems were, and are, essentially repositories for content. Using these systems for this research posed many risks. Paramount amongst these was the necessity of assurance that the researcher's Institute adopted the system for the duration of the research. Indeed, during this research Blackboard was swapped for another CMS, namely Moodle (n.d.).

The lecturer shares their knowledge with students. If the knowledge repository can be organised in a taxonomy based on the content domain, students could effectively and efficiently work with the lecturer's knowledge. In a physical sense, the student would then discuss the content with the lecturer and as this would be a two way process, both would be able to construct new knowledge.

Can this be simulated in a virtual sense? The ubiquitous nature of the Internet and its associated technologies provides a way to facilitate this process, and a means to create a repository that can manage and store the collective knowledge.

In the real world, when a student wishes to acquire knowledge, they can either do research by reading, or they can approach an expert. The

## Chapter 1

interactive nature of the expert provides insights and explanations that are often not present in a written form. Different experts provide different insights, and provide richness in the learning experience. The learning therefore is centred as much around a person as it is on content.

In early Grecian times (around 400BC) students would travel to seek tuition of an individual, such as Socrates. To quote Mendelssohn (1767, “Socrates Battles the Sophists”);

*“Socrates' fame spread all over Greece, and the most respected and educated men from all around came to him, in order to enjoy his friendly company and instruction. The desire to hear him was so great among his friends, that many risked their lives just to be with him daily.”*

Today conferences use keynote speakers, paper and poster presentations as a way to disseminate an expert's knowledge.

For a more modern context, Thomas and Rothery (2005) in an article on online repositories discuss examples of the types of learning materials in use: publicly-funded learning objects, tutor-recommended Web site links and tutor-created content. They indicate that personal content is created by most academics and teachers in the course of their work, and this may be as “basic as a one-page PDF document, or as complex as a set of Macromedia (now Adobe) Flash animations”. How this content can be shared is a focus of this research.

Education and the accumulation of knowledge is a shared enterprise (Taylor, n.d., IV), that is, knowledge is collected when lecturer and students discuss, when a book is read, sounds are listened to, videos are viewed and so forth.

## 1.2 Students and users as moderators and contributors

Today's organisations have well developed systems for capturing financial data and producing reliable and accurate information. An area often overlooked is the importance of knowledge held by individuals within the organization. This is also true in an educational setting, where learners can contribute real-world and personal experiences.

A teacher is required to maintain an ever increasing repository of information and knowledge while learners, particularly in a tertiary environment will often have insights and specialised information and knowledge which could enhance the knowledge of both teacher and peers, and improve the quality of teaching resources. This is emphasised by Meisenberger and Seiwald (2002), who stated that *"most knowledge is socially derived"*. As an example, Taylor (n.d., IV) in a letter to his students wrote:

*"By its very nature, education and the accumulation of knowledge is a shared enterprise. None of us has the time, let alone the background knowledge required, to learn everything on our own. Virtually everything we know has come to us because someone else has taken the time to think about something, research it, and then share what s/he's learned with us in a class lecture or, more likely, in an article or book."*

Students can provide valuable resources in many ways, for example, they can contribute from their own "real-world" experiences (as cited earlier, the student in the banking industry related the content to the coding systems on cheques and credit cards). Another way they could contribute is by adding content found when researching a topic whether in a learner directed mode or discovery learning mode. This knowledge is often held by the individuals and could be of benefit to their peers.

## Chapter 1

A second and equally important part students can play is in moderating resources. In one instance, a student pointed out the following content that had become outdated: "... *modern computer that would support multimedia was a 486 with a large 20MB Hard Drive*"!

The issue therefore was how to capture the knowledge and experience from the students and others, and place it into the correct context. In a f2f teaching environment, such as a lecture, students contribute to the content under the lecturer's guidance within the bounds of the context being discussed. When a student is working with the content out of class and wishes to add, amend or suggest something, there are few mechanisms available that allow this to be added *in context*. Typically using Web technologies, this is done via e-mail or through electronic discussion boards. In both of these cases the knowledge is separated from the content (out of context) and significant time and effort is required to join the content to the knowledge. This unfortunately often does not happen and is a barrier to iterative improvement of content.

A common way in which our individual learning is managed is through the creation of a personal portfolio of facts, information, knowledge and insights. Traditionally this has been achieved through summarising content, discussion, observations, and/or organising them in paper based or electronic systems. With the huge amount of content available, particularly on the World Wide Web, new techniques need to be developed to help manage this personal learning content. Web based portfolios can range from a static web site that contains notes and media files arranged around a user defined taxonomy, to sophisticated content management systems.

One problem therefore, is how can the process of storing facts, information, knowledge and insights for retention and dissemination be improved? For example: in discussions with students, their thoughts could be written down and collected; or when referring to an object (e.g. a book), or a media object

(e.g. a photo), if there were metadata saved with the source in a standard and structured format, the context and content could be retained.

In this thesis the research investigates the development and evolution of a computer based support system designed to enhance information and knowledge acquisition, management and dissemination in a teaching and learning environment, with a goal to develop a generalized framework. Of particular importance was the fact that the information and knowledge is kept in context. An additional goal was the ability to use technology to enhance both content sharing and improve the quality of knowledge acquisition.

There is increasing interest in developing systems based on an individual. The January 2006 issue of the Communications of the Association for Computing Machinery (CACM) featured Personal Information Management Systems which range from systems designed to capture everything that occurs in one's life ("MyLifeBits" in Gemmell, Bell, & Lueder, 2006) to managing personal medical data to aid in future diagnosis (Pratt, Unruh, Civan, & Skeels, 2006). Online systems such as MySpace (<http://www.myspace.com>) and Bebo (<http://www.bebo.com>) that are centred on an individual have become very popular over a very short space of time (Spanbauer, Dec 2006/ Jan 2007). Alongside this is the advancing integration of mobile technologies with SMS text messaging, sound file sharing and podcasting. Many of these systems form the backbone of Web 2.0 (O'Reilly, 2005), where "controlling your own data" is a central principle.

Developing content on a Web based platform provides an opportunity for many different user groups to participate. The accessibility provided by the Internet means that not only is the material available to current students, but many other user groups as well.

Once a knowledge repository has been created, access can be by the person who owns the repository and with appropriate permissions, visitors. The context diagram (Figure 1-1) shows users who could interact with this



knowledge repository. As the knowledge base grows, this would represent more and more the knowledge of an individual, and as such, could be considered as a virtual representation of that individual (a **virtualMe**).

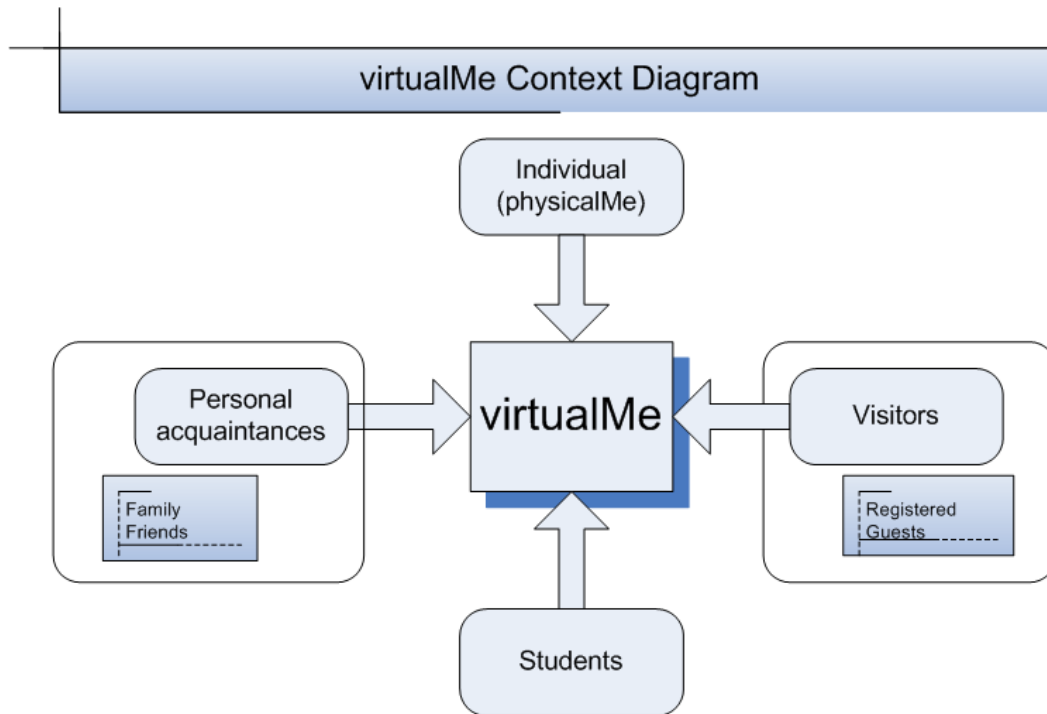


Figure 1-1: virtualMe Context Diagram

### 1.3 Scope and definitions:

The initial scope considered in this thesis is to develop a “metadata schema for divergent data types to be acquired at the source”, and this can be broken down as follows:

**Metadata** is often defined as “data about data”. In the context of this research the metadata will only make sense if it is embedded in a **schema**, which has structure and therefore a context.

**Divergent data types** is a phrase used to identify that this research will consider many media types, from unstructured data elements (e.g., text, images, animation, sound and video), to structured elements (e.g., PowerPoint presentations, Word-processing documents, Flash files, PDF files).

**Acquired**, identifies a collection process but alongside acquisition, the collection is only useful if it can be logically organised, usefully retrieved and shared.

**Source**, identifies the information and knowledge of the participants, and is not intended to imply that the source is the original author or artefact. For example, an observation derived from a published artefact, for the purposes of this research, would be considered “at source”.

So in the context of this research, the investigation is to develop and discuss a framework that allows information and knowledge made up of many different media elements to be acquired from the participants that use the framework.

In order to conduct the research it needs to take place in a context, and as there is a need to acquire information and knowledge in a teaching and learning context, this was a suitable and appropriate environment.

## **1.4 Research question**

Through the action research and literature review the overall research question evolved into:

*Can a framework be developed to acquire contextualized information and knowledge that may exist in a variety of data types, at source?*

Once the proposed virtualMe framework was developed, the final phase of the action research was to validate the framework, by looking at the features and attempting to gauge their perceived usefulness, that is:

*What features are important in a framework to acquire contextualized information and knowledge that may exist in a variety of data types, at source in a teaching and learning environment?”*

To clarify the meaning of the research question, the terms are defined as follows:

**“Contextualised information and knowledge”** is a phrase that means the information and knowledge is placed in a context that gives it meaning. This can be achieved through: attaching to a **taxonomy** (e.g. an ordered list), attaching to an existing artefact (e.g. an image), or by adding **metadata**. Further, the information and knowledge is only useful if placed in an environmental context, which for this research is teaching and learning.

**“A variety of data types”** clarifies “divergent data types” and identifies that this research looks at many media types, both structured and unstructured.

**“Acquire”** and **“Source”** were described previously.

So in the context of this research, the investigation develops and discusses a framework that allows information and knowledge made up of many different media elements, to be acquired from the participants that use the framework.

## 1.5 Thesis problem statement development

Developing a problem statement has been an evolutionary process. The fundamental issue to be dealt with was “can a structure be developed to acquire, organize and disseminate information and knowledge at source?”

Initially, teaching content was transferred to an electronic medium. As the Web became interactive with extensive database capability, many possibilities to enhance information and knowledge acquisition emerged.

Since the technology related to this research was constantly changing, an action research approach allowed for the development of the ideas to be worked in parallel with the technology. Prototypes were developed, trialled

10

and modified. Although there were numerous iterations, the last two prototypes provided the elements necessary for this research: V/2-Online which was the first database driven prototype, which evolved into the virtualMe prototype.

A literature review placed the research into a current practice context, and explored related issues.

Problem statements were developed covering four areas and were the focus of the prototypes that led to the development of the virtualMe framework. These can be summarized in the following points:

1. Overall framework: As stated previously, *“what features are desirable in a generalized framework that allow for the acquisition, management and sharing of an individual’s information and knowledge in an educational environment?”*
2. Annotation framework: *“Can a framework be developed that allows other people to add information and knowledge that will benefit all users of the system?”*
3. Resource acquisition, management and sharing at source: *“Can a model be developed that has the ability to retain context while transferring the content from one person to another and from one place to another?”*
4. Teaching and Learning: *“Does the proposed framework provide additional benefits that are not available in current teaching and learning environments?”*

The final part of the research was to ascertain the efficacy of the developed framework, and a survey of users and potential users was conducted to look at the perceived usefulness.

## 1.6 Research methodology

The methodology used to develop and evaluate the framework used qualitative and quantitative research techniques, and these are illustrated in Figure 1-2 (based on Collecutt, Douglas, Mardle, & Fielden, 2006, Figure 5).

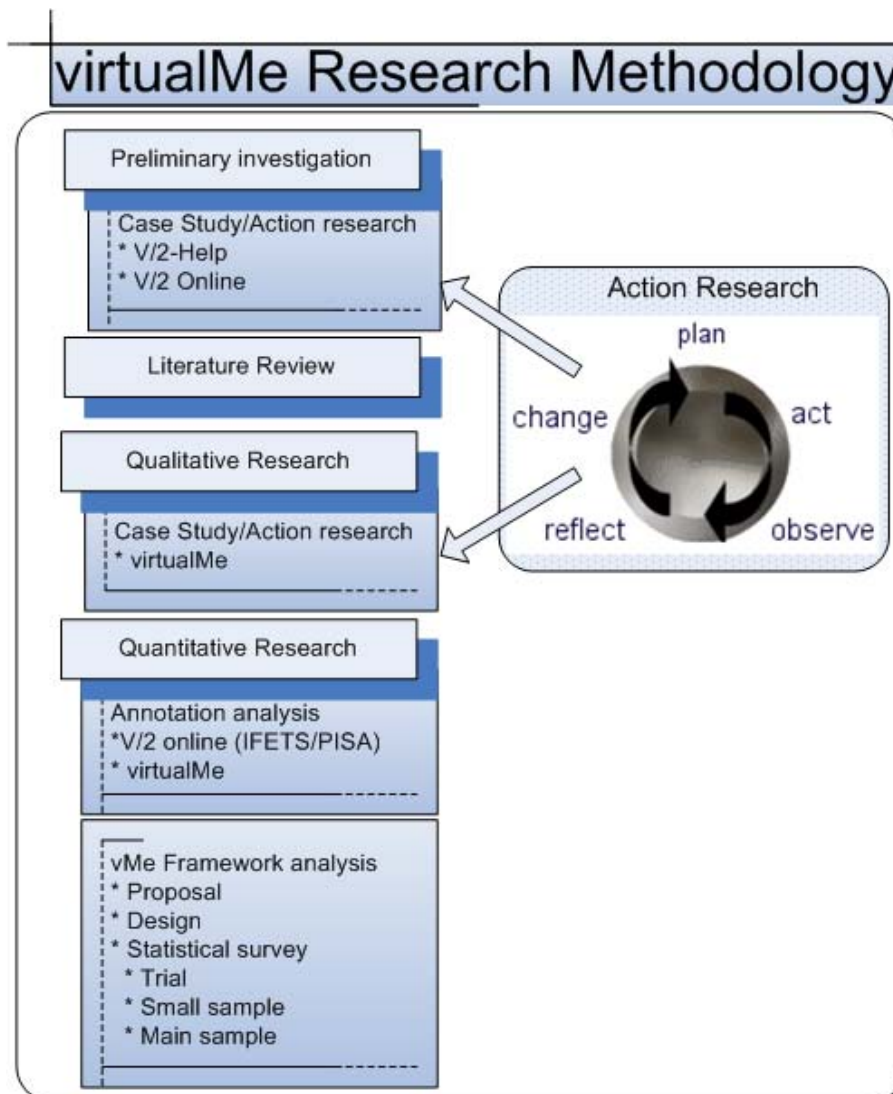


Figure 1-2: Research technologies used in virtualMe

A participatory action research case study approach was followed since the researcher was (and is) employed as a f2f lecturer, enabling ideas and concepts to be implemented and trialled. As designer, developer, and user, combined with: the ability to discuss formally and informally with students;

to implement enhancements and then trial them in a live situation; and to create a system that would automatically gather usage and footprint statistics, this provided a unique opportunity to combine the theory and the practice. To support observation and reflection, surveys have been conducted and usage analysis has been done.

Developmental research began in the mid 1990s, when teaching content was converted from paper based systems to a Windows Help based system. With the introduction of Web technologies the Windows Help files were transferred to static HTML files (Verhaart, 1998).

Database capability was introduced in the early 2000s, and enabled the introduction and development of interactive Web based systems, particularly in the ability for users to enter data, information and knowledge directly. Initially this was via bulletin boards and email, but as the volume of electronic artefacts increased, keeping user entered data in context became more important. An observation that students contribute in a f2f learning situation with their experiences and knowledge, led to research into whether this could be harnessed to improve the quality of the content. A prototype capable of being annotated was developed, and was trialled from 2002.

Several research papers have been published that track the evolution of the framework (Verhaart, 2002; Verhaart, 2003b; Verhaart M., Jamieson J. & Kinshuk, 2004; Verhaart M. & Kinshuk, 2004b; Verhaart M., & Kinshuk, 2006a; Verhaart M., & Kinshuk, 2006b; Verhaart, 2007; Verhaart & Kinshuk, 2007; Verhaart, 2008), and these are summarized in Appendix F.

The final stage of the research was to gather evidence to support the research questions. A user survey using the Technology Acceptance Model (TAM) (Davis 1989) was developed. TAM is a well respected method used to evaluate information technology-based systems, and has proven to be a reasonably accurate predictor of both users' intentions and the system usage.

## 1.7 Problem statements and methodologies

As indicated earlier, four areas emerged as relevant to this research. Three techniques were used to identify the issues and evaluate the effectiveness, and have been used to support this research, namely: literature review; prototype development; and surveying. Once the virtualMe framework was defined the problem statements listed earlier were refined and are listed in Table 1-1 with their interrelationships with the research methodology.

Table 1-1: Problem statements with associated methodologies

		Methodology
1.	Overall framework	
	<i>What features are desirable in a framework that allows for the acquisition, management and sharing of an individual's information and knowledge that may exist in a variety of data types, at source in a teaching and learning environment?</i>	
	<ul style="list-style-type: none"> <li>• <i>Develop a list of features.</i></li> </ul>	Literature review and prototypes
	<ul style="list-style-type: none"> <li>• <i>Investigate perceived usefulness.</i></li> </ul>	Survey
2.	Annotation framework	
	<i>What features are desirable in a framework that would enable other people to add information and knowledge that will benefit all users of the system?</i>	Literature review and prototypes
	<i>In the virtualMe which annotation features are perceived to be useful?</i>	Survey
3.	Resource acquisition, management and sharing at source	
	<i>"What features are desirable in an electronic digital asset model that has the ability to retain context while transferring the content from one person to another and from one place to another?"</i>	Literature review and prototypes.
	<i>"The virtualMe framework introduces the MMO model to manage digital assets. Which features are perceived to be useful by users?"</i>	Survey
4.	Teaching and Learning	
	<i>What features are desirable in a blended (online and face-to-face) teaching and learning environment?</i>	Literature review and prototypes.
	<i>"What benefits does the virtualMe framework provide for teachers and learners?"</i>	Survey

## 1.8 Conclusion

The contribution of this research is a framework that enables information and knowledge to be captured, organized and disseminated in a standard and structured way.

This thesis describes the process, investigation and findings of the research that investigates the following:

- 1) a framework that can be used in a teaching and learning environment that encourages the collection and sharing of an individual's information and knowledge;
- 2) a structure that allows comments to be captured in context; and
- 3) technology to allow for the acquisition, display and sharing of data in a variety of structured and unstructured media formats.

The thesis begins with a discussion on the methodology used to conduct the research, and is followed by a discussion on the preliminary action research that helped refine the research question and identify the associated problems definitions. A review of the literature follows, placing the research in the context of existing body of knowledge. Based on the preliminary investigation and the literature review, two major action research cycles are described: the V/2-Online framework, where ideas were developed, and the virtualMe framework. This is followed by a discussion of the findings of a survey conducted to ascertain the perceived usefulness of the virtualMe framework. The thesis concludes with a description of the features of the virtualMe framework, with comments as to how it could be useful in existing or future applications.



## **2 Methodology**

In order to provide structure to the phases of the research, an appropriate methodology based on other research paradigms and techniques was developed. As a technology based project, several techniques were integrated, since this research encompasses reviewing the literature, developing a framework, learning suitable technologies, implementing a functioning system and evaluating the system against initial objectives. This chapter provides the background of the methodology adopted in this research.

### **2.1 Introduction**

The overall aim of this research was to develop a metadata schema to enable the acquisition of information and knowledge in context at source in a teaching and learning environment. The methodology in this research follows a framework described by Bournier (2002). In the Bournier framework, four phases are identified; reviewing the field of study, theory building, theory testing, and finally, reflection and integration.

Bournier (2002) suggested that most research either follows from identifying a gap in the literature or from an awareness of a problem worth solving. In the case of this research, the problem of capturing the information and knowledge of students in a face-to-face class was identified as a problem and the ability to adapt internet technologies provided a research direction.

In order to develop the potential research question(s), an investigative phase preceded reviewing the field of study, and in this thesis this preliminary stage is included, as it provides a context to the problems, analysis and reflection that follow.

Hence a five phase framework was used to develop the virtualMe and is illustrated in Figure 2-1.

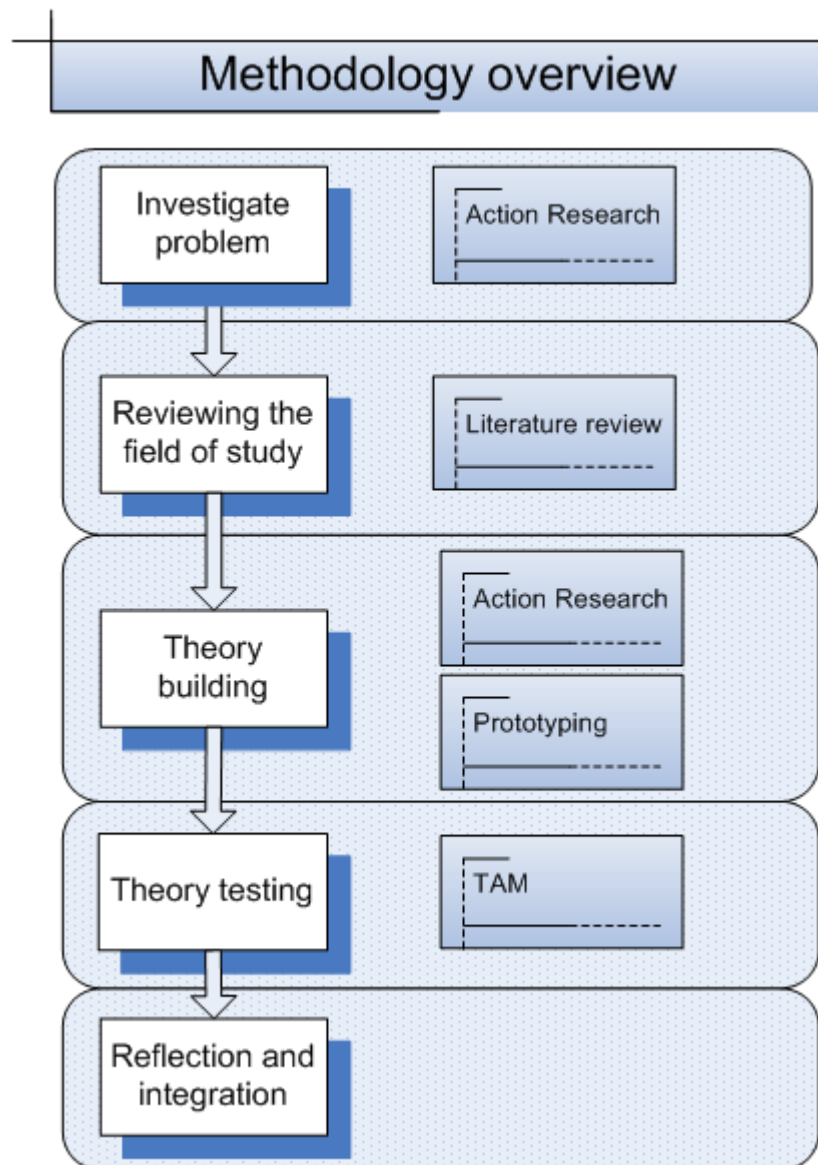


Figure 2-1: Research framework used in virtualMe framework (based on Bourner, 2002)

What techniques are used in instructional technology research? Collecutt, Douglas, Mardle, & Fielden, (2006) reviewed five years of instructional technology research in New Zealand, from 2001-2006. They identified three basic research techniques: literature review; quantitative research; and qualitative research. Figure 2-2 illustrates these (based on Collecutt, Douglas, Mardle, & Fielden, 2006, Figure 5) in relation to the virtualMe in the framework suggested by Bourner (2002).

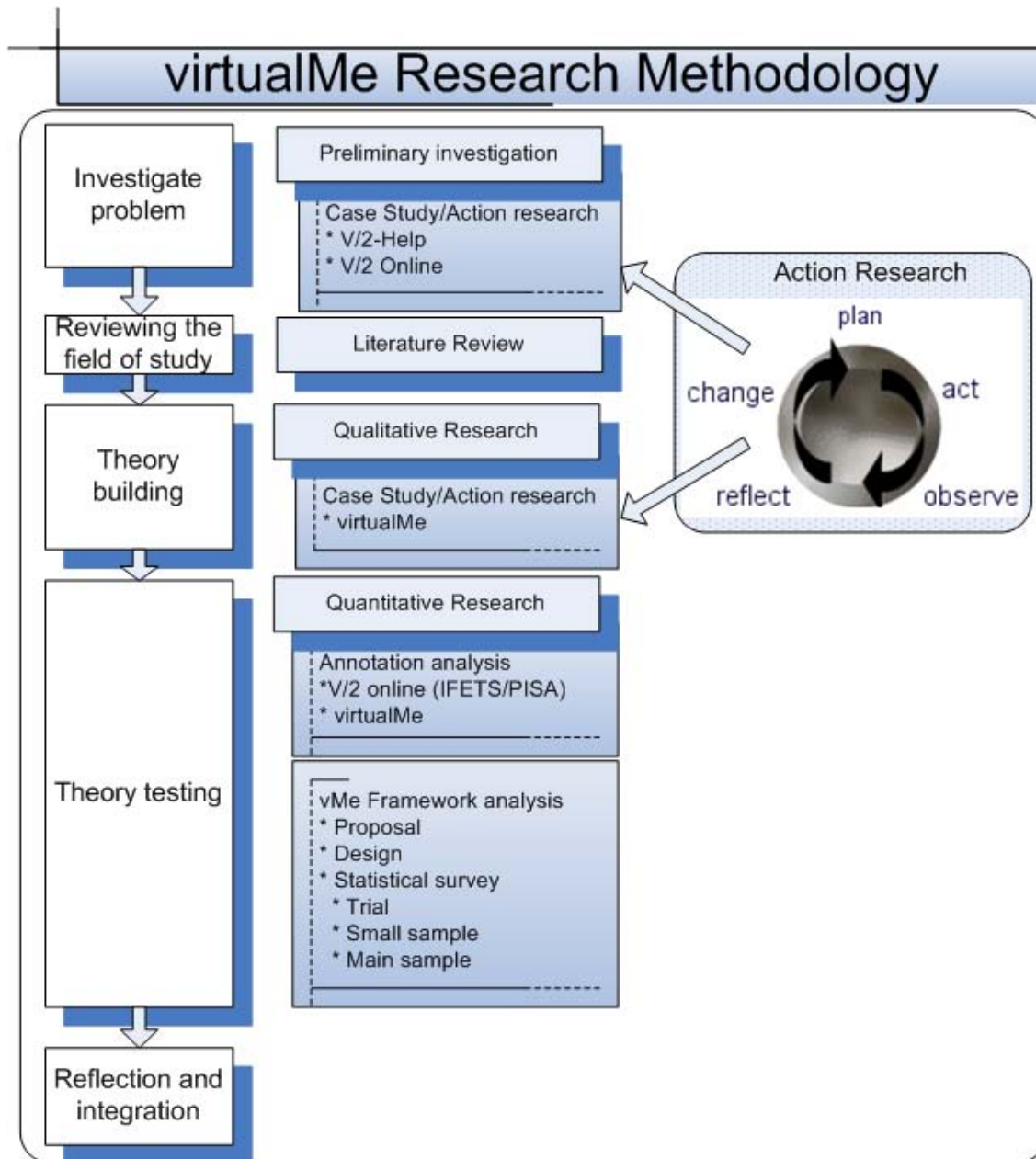


Figure 2-2: Research technologies used in virtualMe

The use of quantitative research methods is further supported by Myers (2008, Introduction) who states that “in Information Systems, there has been a general shift in IS research away from technological to managerial and organizational issues, hence an increasing interest in the application of qualitative research methods.” Qualitative research methods described in the paper include: action research, case study research, ethnography and grounded theory.

## **2.2 Five stage methodology framework**

In this thesis the five phase methodology framework illustrated in Figure 2-1 and Figure 2-2 has been followed:

1. Investigating and refining the problem.
2. Reviewing the field of study.
3. Theory building.
4. Theory testing.
5. Reflection and integration.

### **2.2.1 Investigating and refining the problem**

During this phase the problem definition was developed and the scope and type of research was analysed. This phase started well before the research questions were considered and was based on experiences and observations that would lead to the research questions. In the case of this research an *Action Research* technique was adopted, and prototype systems were developed, trialled and modified. The design and implementation of the prototypes also enabled the skills in the supporting technologies to be developed.

Action research is a widely used technique, first appearing in a paper by K. Lewin in 1946. It refers to research conducted to solve a social problem, although its differentiating factor from other research methods is that of finding a solution (Dane, 1990, p. 8). McNiff (2002) described action research as open ended, which does not begin with a fixed hypothesis, but an idea that is developed.

Dick (2002) defined Action Research as “a flexible spiral process which allows action (change, improvement) and research (understanding, knowledge) to be achieved at the same time. The understanding allows more informed change and at the same time is informed by that change. People affected by the change are usually involved in the action research. This

allows the understanding to be widely shared and the change to be pursued with commitment.”

Reason & Bradbury (2001, p. 1) defined Action Research as *“a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and are generally the flourishing of individual persons and their communities.”*

There are several strategies that are used to conduct action research: action science; cooperative enquiry (Heron & Reason, 2001); participatory action research (PAR); developmental action inquiry; and the living theory approach (Wikipedia, 2007).

For this research, participatory action research is found as an appropriate tool, because it is a recognized form of experimental research that focuses on the effects of the researcher's direct actions of practice within a participatory community with the goal of improving the performance quality of the community or an area of concern (Wadsworth, 1998; Reason & Bradbury, 2001).

In summary, the action-research cycle consists of plan, act, observe, reflect and change (Figure 2-2).

In information technology, models or frameworks should be supported by a software artefact, to test the research questions and validate the model or framework, and implementation of the artefact requires a software development methodology.

There are many techniques used to develop information technology based systems. Bentley and Whitten (2007, p. 92) identify many alternative routes and strategies and describe many such techniques including:

- Rapid Application Development (RAD),
- Joint Application Development (JAD),
- Framework for Application System Technologies (FAST),
- Waterfall,
- Object oriented analysis (OOA),
- Prototyping,
- Information Engineering (IE), and
- Model driven development (MDD).

A traditional process for conducting an information systems development project is the systems development life cycle (SDLC), which is a software engineering approach specifying the following stages (Hoffer, Prescott & McFadden, 2007, p.43; Gibson & Hughes ,1994, pp. 110-131):

- Planning: Identifies the scope and boundary of problem, development strategies are planned and goals are established.
- Requirements analysis: Identifies what the project should do.
- Design: Identifies how the project is going to work.
- Implementation & testing: Produces different media components and integrates them together using an authoring tool.
- Support: Corrects errors, improves and enhances the application.

Sommerville (2007) identifies three software process models used in software engineering:

- waterfall
- evolutionary (exploratory and prototyping), and
- component-based software engineering.

*Component-based software engineering* focuses on integrating reusable components rather than developing a system from scratch (Sommerville, 2007, p.65) and as such was not considered a suitable technique for this research.

The *waterfall* approach introduced by Royce in 1970 (Larman & Basili, 2003; Sommerville, 2007, pp. 66-68), formalises program development and facilitates documentation. It usually requires that the final specifications can be well defined and that the application progress passes sequentially from one phase to the next (in reality overlap and revisiting occurs). Connors (1992), stated that “the entire process moves in lockstep”. This is illustrated in Figure 2-3.

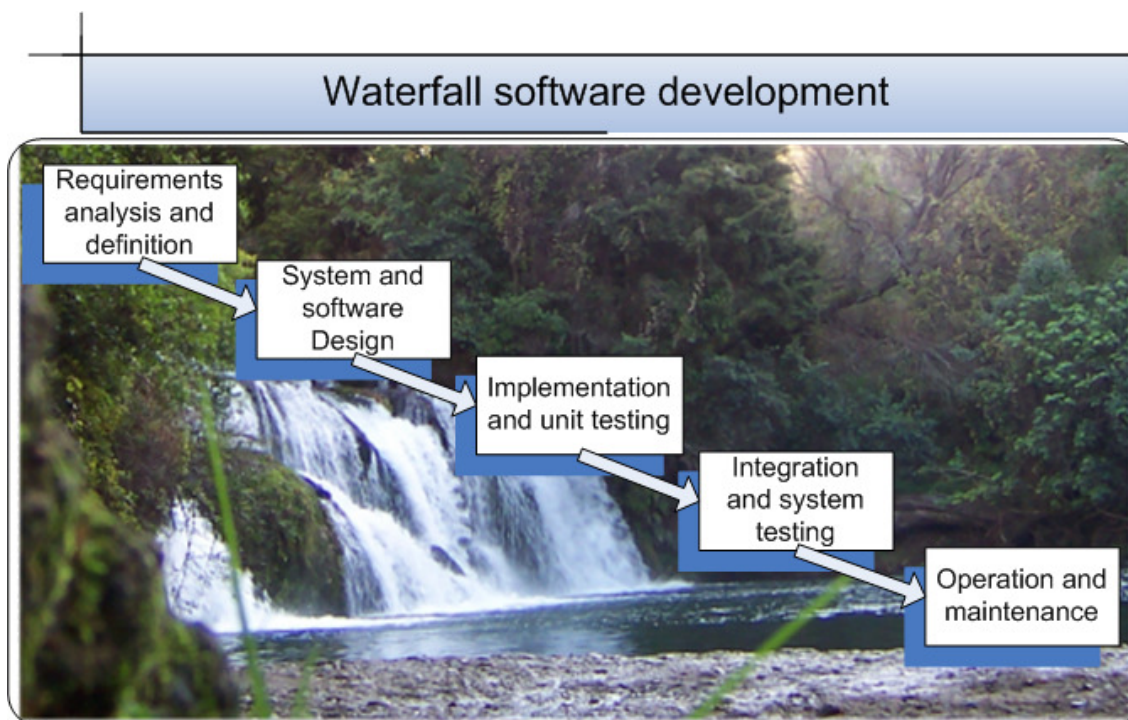


Figure 2-3: Waterfall development methodology (based on Sommerville (2007, p.67))

*Evolutionary development* interleaves the activities of specification, development, and validation. Sommerville (2007) identifies two fundamental types: exploratory and throwaway prototyping, where an initial system is rapidly developed from abstract specifications.

*Exploratory development* is an iterative process where an initial solution is implemented based on parts of the system that are understood and modified by adding new features until the project is complete (Sommerville, 2007, pp. 68-69). This technique is more suited to multimedia game development, and

requires rapid iterations and high level programming tools, and is used when specifications are difficult or correctness is not paramount.

*Prototyping* is similar to exploratory programming, but the main objective is to generate requirements. Throwaway, or rapid prototyping, refers to creating a model that will eventually be thrown away (Sommerville, 2007, pp.68-69), and in this research the throwaway approach has been used for several reasons. Firstly, the web technologies are in a continuous state of change, for example, this research has spanned the use of static web pages (using raw html) through database driven web technologies from *active server pages* to the current object oriented Microsoft .Net framework. Further it is envisaged that the research would be adapted to existing systems, for example as an add-in to a standard web browser or applications such as the PHP based, Learning Management System Moodle. Three distinct prototypes were evolved during the development of the virtualMe framework.

As described by Burns and Dennis (1985, p.19) “rather than force the user to attempt to understand the many minute details of a paper system design specification (often several hundred pages), the developer presents the user with a series of rough approximations (or prototypes) of the computer system. The prototype is not a paper specification of the system, but a working model of the system, albeit often incomplete”.

Bentley and Whitten (2007, pp. 448-450) list advantages and disadvantages of the prototyping approach. The advantages of prototyping include:

- active end-user participation;
- following the natural consequence of systems development, iteration and change;
- allowing end users to see a system based on incomplete specifications;
- allowing users to see, touch, feel and experience the system;
- detecting errors much sooner than a paper based model;



## Chapter 2

- increasing creativity as it allows for quicker user feedback, which can lead to better solutions; and
- accelerating several phases of the life cycle and phases may be consolidated.

Prototyping disadvantages include:

- returning to a code and repair cycle that can create maintenance problems;
- solving the wrong problems;
- overlooking design issues;
- premature commitment to a final design;
- escalating scope and complexity beyond initial design specifications;
- reduction of creativity in designs; and
- slower performance.

McEwan (2001) and Sommerville (2007) stated that the main object of the prototype is to generate requirements. Figure 2-4 shows the relationship of prototyping within the software life cycle.

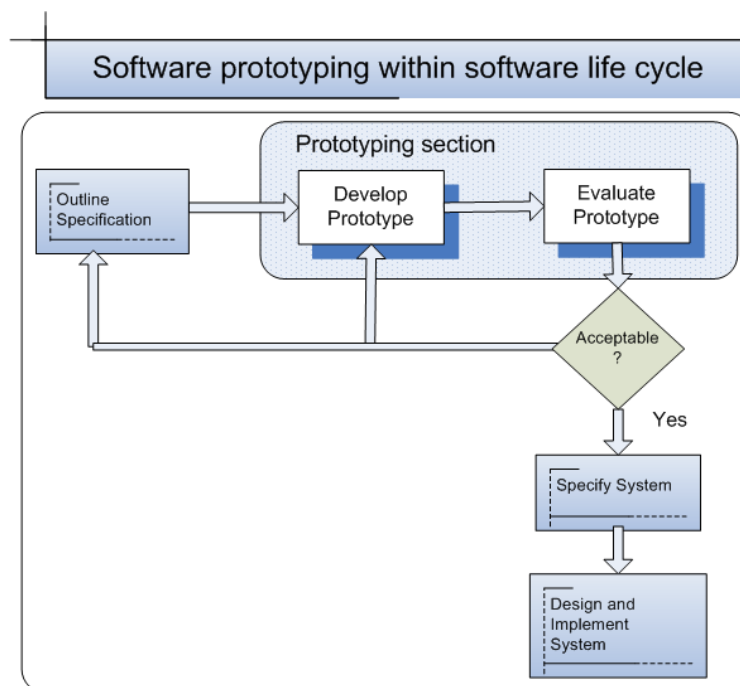


Figure 2-4: Prototyping software methodology

As the purpose of this research was to develop a metadata schema for information and knowledge acquisition, and a software artefact was created to test the developing frameworks and models, this is ideally suited to prototyping.

In order to develop the metadata schema, a conceptual model was developed, and a physical model was then created. At the same time supporting technologies were learnt and used to develop the artefact.

Successive prototypes have been used in actual blended teaching and learning, and in most cases aligned closely with the content being delivered. Courses included *Internet and web page development*, *multimedia* and *database management systems*. The prototypes have been presented at conferences and seminars and feedback from these have helped in the action research iterations.

The action research technique has been used through the development and deployment of prototypes. This technique was chosen for two reasons: firstly, computer based technologies and in particular web technologies change rapidly, and secondly, the technique allowed for continual modification and evolution of concepts and ideas through design, implementation, use and feedback.

From the initial prototypes and literature review, four areas for research were identified:

- An overall framework that could be used in an enhanced teaching and learning environment;
- An annotation framework that enabled the acquisition both in and out of context to acquire users' information and knowledge;
- A resource acquisition , management and sharing model; and
- Whether the framework and models supported teaching and learning.

### **2.2.2 Reviewing the field of study**

Bourner (2002) suggested that research is either based on a gap identified from the literature or an awareness of a problem worth solving, and reasons for conducting a literature review is given. Reasons include: identifying gaps in knowledge; avoiding reinventing the wheel; carry on from where others have left off; identify other researchers in the same field; identify seminal works; provide intellectual context; identify opposing views; place this work in perspective; provide evidence that significant work in the same area can be accessed; discover transferable information and ideas; and to discover transferable research methods. The research presented in this thesis arose from the observation that students in a class have the possibility to make valuable contributions which are often lost after the discussion, or not articulated during the discussion. During the “investigation of the problem” phase, four areas for research, mentioned in previous section, were identified. To support the research, a literature review was carried out.

### **2.2.3 Theory building (developing a model or framework)**

Combining the action research from the problem identification phase and the literature review, the virtualMe framework evolved. Based on the framework and integrated models, the research questions were developed.

### **2.2.4 Theory testing (evaluating the model)**

In order to test the framework a working model was developed. As in the initial phase, an action research approach was taken and the model was tested in a blended teaching and learning environment.

Freire (1972 cited in Hills, 2001), stated that “engaging in critical dialog is empowering and transformative because, through the process of dialog, people become ‘masters of their thinking and views of the world explicitly or implicitly manifest in their own suggestions and those of their comrades’”. In

action research the term “*critical friend*” is used to describe a mentor/colleague in this role. Kember, Ha, Lam, Lee, NG, Yan, and Yum (1997) described the diverse roles of the critical friend that include financier, project design consultant, rapport builder, coffee maker, mirror, teaching consultant, evaluation advisor, research advisor, resource provider, writing consultant, match maker, and deadline enforcer. In conducting this research many colleagues (and students) filled these roles, and in many cases several of the roles, for example, through discussion (informally and in structured discussion forum), and in writing and/or presenting papers or chapters for publication.

Qualitative analysis has been used to evaluate the action research undertaken for this thesis. For qualitative analysis, different inquiry techniques have been described by Patton (2002, pp.132-133: Exhibit 3.6).

Based on these techniques, developing and evolving the artefact through prototyping that involved the researcher and students meant that the research was conducted primarily using heuristic inquiry. Patton (2002) used the central question “What is my experience of this phenomenon and the essential experience of others who also experience this phenomenon intensely”? Moustakas (1990, cited in Patton 2002, p.107) stated that “the self of the researcher is present throughout the process and, while understanding the phenomenon with increasing depth, the researcher also experiences growing self awareness and self-knowledge. Heuristic processes incorporate creative self-processes and self discoveries.” This is distinguishable from phenomenography which is described by Sonnemann (1954, cited in Patton 2002) as “a descriptive recording of immediate subjective experience as reported”, that is, observations are made in real-time.

This study is based on a combination of “implementation evaluation” (Patton, 2002, p 161) and “process evaluation” where questions such as “What do users of the system perceive as useful?” (implementation) and

“What are the strengths and weaknesses of the implemented system?” (process).

In order to evaluate the final framework, quantitative analysis was used. Two different approaches were taken: the first by analysing actual user interaction; and second via a survey, based on the *technology acceptance model*, analysing user perceptions.

#### 2.2.4.1 Technology Acceptance Model

A user survey was used to evaluate the efficacy of the virtualMe. The survey was developed on the basis of the Technology Acceptance Model (TAM), as conceived by Davis (1989) and is illustrated in Figure 2-5. It was originally formulated in an attempt to understand why people accept or reject information systems. It is now a well established and validated method (Lederer, Maupin, Sena & Zhuang, 2000) used to evaluate information technology-based systems, and this is reflected in the fact that the Institute for Scientific Information Social Science Citation Index listed 335 journal citations between 1999 and 2004 on the use of TAM (Money & Turner, 2004). This is further corroborated by Burton-Jones and Hubona (2005), who stated that “an impressive body of research has validated and extended TAM”.

TAM has proven to be a reasonably accurate predictor of both users’ intentions and the system usage and is centred on two primary belief constructs: ease of use and perceived usefulness.

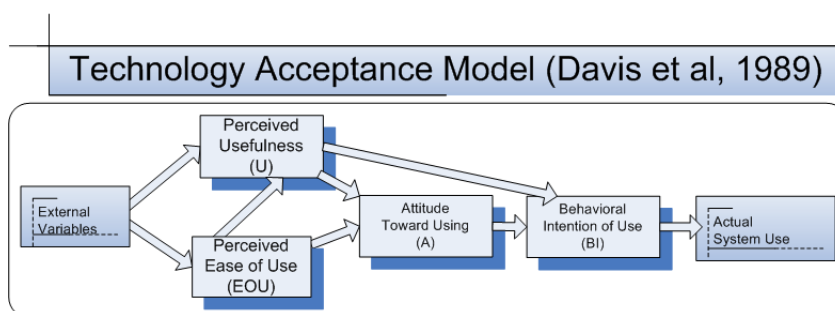


Figure 2-5: Technology Acceptance Model

A revised TAM was proposed later in 1989, by combining the original TAM model with Fishbein and Ajzen's (1980, cited in Szajna, 1996, p.85) *theory of reasoned action*. This includes pre and post implementation analysis with the model reduced to three theoretical constructs; intention, perceived usefulness, and perceived ease of use (Szajna, 1996). However, Szajna (1996) stated that "the findings here (of the paper) combined with results from other studies in this area suggest the original TAM may be more appropriate than the two-version revised TAM".

Following the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975, cited in Burton-Jones & Hubona, 2005), TAM maintains that the decision to use a particular information technology (IT) follows four-stages:

1. External variables reflect beliefs about usefulness: A range of external variables (such as a user's individual abilities, the type of IT, the task, and situational constraints) are considered by users to evaluate the consequences of using an IT. Their overall evaluation is reflected in their beliefs about an IT's usefulness (U) (will it increase their job performance?), and ease of use (EOU) (free from effort);
2. Beliefs about consequences drive attitude: Users' beliefs about the consequences of using an IT (U and EOU) drive their attitude (or affection) toward that behaviour;
3. Attitude drives intention: Attitude drives the extent to which they intend to use it; and
4. Intention drives use: Intention to use drives whether it will actually be used (Ajzen, 2002, cited in Burton-Jones & Hubona, 2005).

#### **2.2.4.2 Evaluating the virtualMe framework**

Research into the virtualMe framework has been conducted in two ways:

- By analysing data collected by the system while users have been working with the prototype; and
- Via a survey of existing and potential users based on the TAM.

#### **2.2.4.2.1    *Prototype usage analysis***

Implementing prototypes and testing them in a “live” environment presents a number of research challenges, particularly where the researcher and participants are actively involved. Patton (2002, p.47) described a Direct Personal Experience and Engagement strategy, and stated that "...closeness (to the research) does not make bias and loss of perspective inevitable; (indeed) distance is no guarantee of objectivity".

#### **2.2.4.2.2    *Survey phase***

The survey underwent several phases: initial design (draft), ethical considerations, pilot testing, data collection, and data analysis.

A **draft survey** of summative (using a likert scale) and formative (in the form of requests for comments) questions was constructed. To ensure face validity, experts in survey research were consulted and their input was used in revision and redesign of questions. Validity in qualitative research depends on careful instrument construction to ensure that the instrument measures what it is supposed to measure (Patton, 2002, p.14).

It is important to note at this stage that a purposeful sampling strategy was adopted, where “*qualitative inquiry typically focuses on relatively small samples ... selected purposefully to permit inquiry into and understanding of phenomenon in depth*” and “*the purpose of purposeful sampling is to select information-rich cases whose study will illuminate the questions under study*” (Patton, 2002, p.46). For this research, those evaluating the system needed to be computer literate and to have experienced the system.

**Ethical approval** was required, as the research was conducted on human subjects.. Two organizations were affected by the research: Massey University, where the researcher is enrolled for doctoral study; and the researcher’s employing institute. Appendix D includes copies of the approval forms from the respective institutes.

A **pilot test** with 11 volunteers consisting of colleagues and students was conducted to establish whether the technology was appropriate, and to ascertain the validity of the content in the survey. Volunteers were asked for feedback, and subsequently, some minor modifications were made.

**Data collection** commenced once the survey instrument and online survey forms were finalized. A variety of user groups were approached, and included:

- Students from the researcher's institute.
- Students from the University the researcher was enrolled in.
- Members from the Advanced Learning Technology Research Centre, Massey University, and students in any classes to which virtualMe would be presented.
- Colleagues from other institutions including members of the International Forum of Educational Technology and Society (IFETS, 2007) online discussion forum, which is a global network of educators and practitioners in distance education and electronic learning technologies.
- Academic staff from the researcher's employing institute.
- Other Staff/students in the Polytechnic/Institute of Technology sector in New Zealand.

**Data analysis** was conducted on the survey responses against the TAM criteria.



### 2.2.5 Reflection and integration

There are many things that can be reflected upon when concluding this thesis: what was learnt in the process; what could have been done differently; what are personal strengths and weaknesses, and so on.

Bourner (2002, p. 10) stated that a critical reflection is “*how the research findings relate to current thinking in the field or topic of the research*”. This will include an assessment of where the research fits into the field of knowledge. This will include how the research: adds to what is already known; connects to current thinking; challenges current thinking.

It is likely that the reflection will pose further questions and possible research directions, and these new questions can be an important outcome of the research (Bourner, 2002).

Based on Bourner (2002) some implications of this research will include:

- Filling a gap in the literature (through publications);
- Producing a solution to an identified problem (capturing student information and knowledge);
- Clarify specific areas (Annotations added in a web environment);
- Suggest a synthesis of existing ideas (developing a framework, merging several standards into the multimedia object, integrating web technologies into a teaching and learning environment);
- New ideas suggested;
- Generate new questions; and
- Implications for new research.

## **2.3 Conclusion**

This chapter outlined the methodology that was used in this research. A five stage framework, based on Bournier (2002) was discussed consisting of: investigating the problem, reviewing the field of study, theory building, theory testing, and reflection and integration. Key techniques include: literature review, action research, surveying (through using the technology acceptance model), and for the model development, prototyping.

A background to the research will be covered in the following chapters that establish the basis for this research, followed by a literature review.

### **3 Literature review**

Reviewing the literature is an important component of research as it places the study in a past and present context, and typically precedes the research. Marshall and Rossman (1989 cited by Patton 2002, p. 226) stated that a literature review can occur simultaneously with the fieldwork, permitting a creative interplay among the processes of data collection, literature review and researcher introspection. This was the case for this study, with the literature review and action research (as described in the previous chapters) done in tandem, with the action research highlighting areas relevant to this study prior to the development of the proposed framework.

As this research progressed, many publications were produced for journals, conferences and book chapters that helped to provide researcher introspection (please refer to Appendix F for a list of the publications with abstracts).

#### **3.1 Introduction**

In face-to-face (f2f), virtual or blended environments, both the educators and their students are continually expanding their knowledge through instruction or research. From an educator's perspective, the information and knowledge needs to be managed and organized in such a way as to be a useful resource for both themselves and their students. Also, students have personal information and knowledge that could be usefully shared and would be beneficial to the course being studied. This thesis uses a teaching and learning environment and looks at how information and knowledge in a variety of media formats can be acquired at source, where source is considered to be the educator or student. A framework was developed to support this research.

Based on the work presented in this thesis the literature review focuses in two areas; the acquisition, organisation and dissemination of information

and knowledge (including maintaining context and the advantages of collaborative construction) and research into mechanisms to allow this to be achieved.

### **3.2 Information and knowledge acquisition**

The research presented in this thesis began with the observation that in an enhanced teaching and learning environment (f2f and electronically supported), students can make a significant contribution to the content delivered, particularly where the student may have firsthand experience. The issue therefore was how to organize the teaching material in a way that would enable the acquisition of the knowledge and experience from the students, and others, and place it into the correct context. With the rapid evolution of internet based technologies, a suitable environment was available in which to conduct the research. To help focus the research, a problem statement associated with the overall framework was developed as follows:

*What features and functionality are important in a framework that allows for the acquisition, management and sharing of an individual's information and knowledge in an educational environment?"*  
(Chapter 1, Table 1)

Key issues associated with this problem statement include: consideration of what is information and knowledge, what is meant by acquisition and context, placing the research into the educational context, and consideration of what value is there in shared knowledge acquisition.

Fundamental to this research is understanding what constitutes information and knowledge. From one perspective, the research had to focus on how to manage and organise a lecturer's information and knowledge, and from the second perspective how student information and knowledge could be managed.

### 3.2.1 The knowledge taxonomy

There is some debate as to what knowledge is and how this relates to information. Data, information and knowledge are all building blocks in knowledge systems, with data considered to be the lowest element in a knowledge hierarchy. Figure 3-1 illustrates the knowledge taxonomy as described by Davidson and Voss (2002).

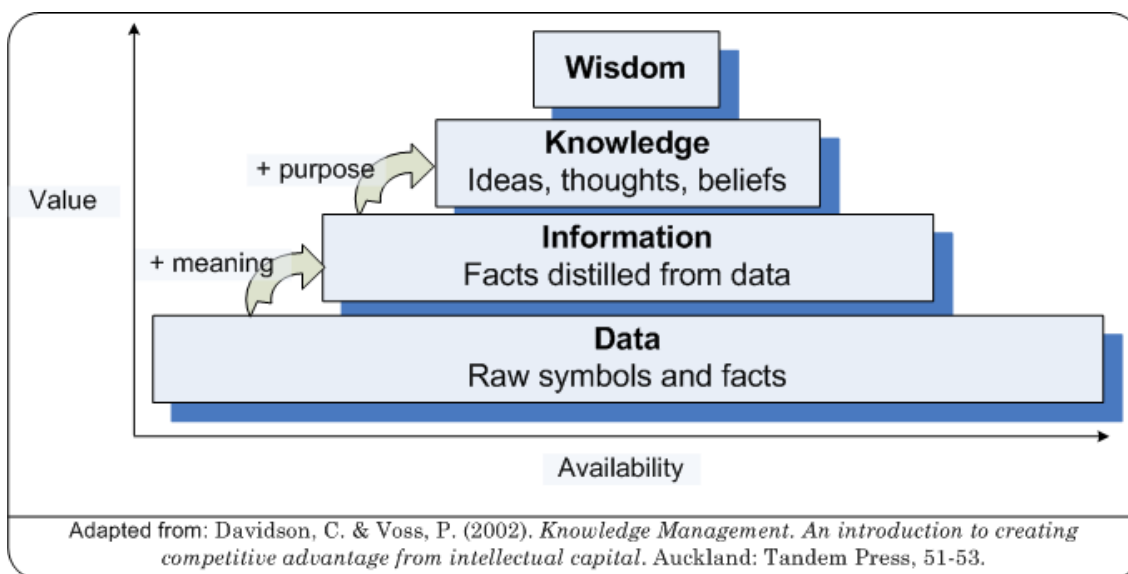


Figure 3-1: Knowledge taxonomy

Davidson and Voss (2002, pp. 52-53) defined *data* as “raw symbols and facts” with no inherent meaning; *information* contains facts that can be distilled from data, and can be thought of as the data that is contextualized; and *knowledge* as “information with a purpose”.

The Interoperability Clearinghouse (n.d.) defines the knowledge taxonomy using the following example. “1234567.89” and “Joe Bloggs” are data, “Your bank balance has jumped 80% to \$1234567.89” is information, “Nobody owes me that much money” is knowledge, and “I’d better talk to the bank before I spend it because of what has happened to other people” is wisdom”.

In order to discuss knowledge acquisition, knowledge itself needs to be defined, and this can range from a philosophical view “what we know”, or

“what is between the ears” (Goppold, 1996), to an operational definition (Quinn, Anderson, & Finkelstein, 1998). Knowledge can be transmitted and stored electronically in a variety of forms, and it would be useful to create it in a homogeneous and consistent way. Text is easily managed, but other multimedia elements, such as audio, graphics, animation, video and structured objects such as PowerPoint presentations, Word documents, Flash files, concept maps and so forth, also need to be handled. Much work is currently underway in this field, for example, researchers at CSIRO Mathematical and Information Sciences in Sydney, Australia are working on adding descriptive tags to audio and video files (Whitfield, 2003).

Meisenberger and Seiwald (2002) considered the issue of knowledge creation as follows:

*“Only a small part of individual knowledge is generated through the process of individual experience. Most parts are socially derived”*  
(p. 10).

Nonaka (1994) described information as “a flow of messages, while knowledge is created and organized by the very flow of information, anchored on the commitment and beliefs of its holder” (p. 15).

If knowledge is “what we know” (Goppold, 1996), then a knowledge system needs to be centred on a specific entity, such as a person or company, so a personal knowledge system captures what a person knows.

Knowledge can exist in a variety of forms. Davidson and Voss (2002) identify three categories: tacit, explicit and missing.

**Tacit** (or implicit) knowledge is that which is not able to be communicated in words and symbols, and is most often associated with the work of philosopher Michael Polanyi (1958). Polanyi described tacit knowledge as “we know more than we can tell” (Polanyi, 1966, cited in Nonaka, 1994, p. 16). It can be thought of as the “feel-right” knowledge, is that which we

use to solve a task, and is based on past experiences and knowledge built up over time. Reber (2003) distinguishes implicit learning as how one develops intuitive knowledge and that it is a foundation process for the development of abstract, tacit knowledge.

**Explicit** knowledge can be written down, and is derived from tacit (implicit) knowledge. For example, if one conveys that a person is a bachelor (an explicit statement), then one conveys two implicit facts (that this person is male and unmarried) without making these features explicit (Dienes & Perner, 1999). Implicit knowledge is often described when explaining explicit knowledge in a f2f lecture.

**Missing** knowledge is that which people should have to complete their work that they currently do not have (Davidson & Voss, 2002). For example, in teaching a new software application the idiosyncrasies of the package may not yet be known. The ability to acquire this missing knowledge from users of the knowledge is an important consideration for this research.

Knowledge can be acquired in a variety of ways. Davenport and Prusak (1998) listed some of the components that contribute to knowledge, such as experience, practical utility (what should work and what really does), speed (ability to solve a problem quickly based on experience), complexity (ability to deal with ambiguity or conflicting information) and evolution (being able to discover what you do not know). They further list some of the processes used to transform information to knowledge such as comparisons, consequences (what the information suggests), connections (relationships) and conversation (synthesizing what others know).

### 3.2.2 Acquisition

Nonaka (1994) described a spiral model that shows knowledge production in organizations as a social process, occurring through a continuous dialog between tacit and explicit knowledge (Figure 3-2). Knowledge creation occurs from: *tacit to tacit* through socialization, *tacit to explicit* by describing

through discussion, *explicit to explicit* by reconfiguring existing information, and *explicit to tacit* by internalization which can be thought of as learning.

For example, in an academic context:

- socialization (tacit to tacit) can occur through f2f classroom/lecture, training, and mentoring;
- externalisation (tacit to explicit) can occur through mentoring, training, online and offline discussion, reflection, assessments (assignments, tests, examinations), projects, and brainstorming;
- combination (explicit to explicit) can occur through meetings, email, online and offline course notes, assignments, tests, projects, online and offline discussions, groupware and video-conferencing; and
- internalisation (explicit to tacit) can occur through study using online and offline repositories, and practical experiences.

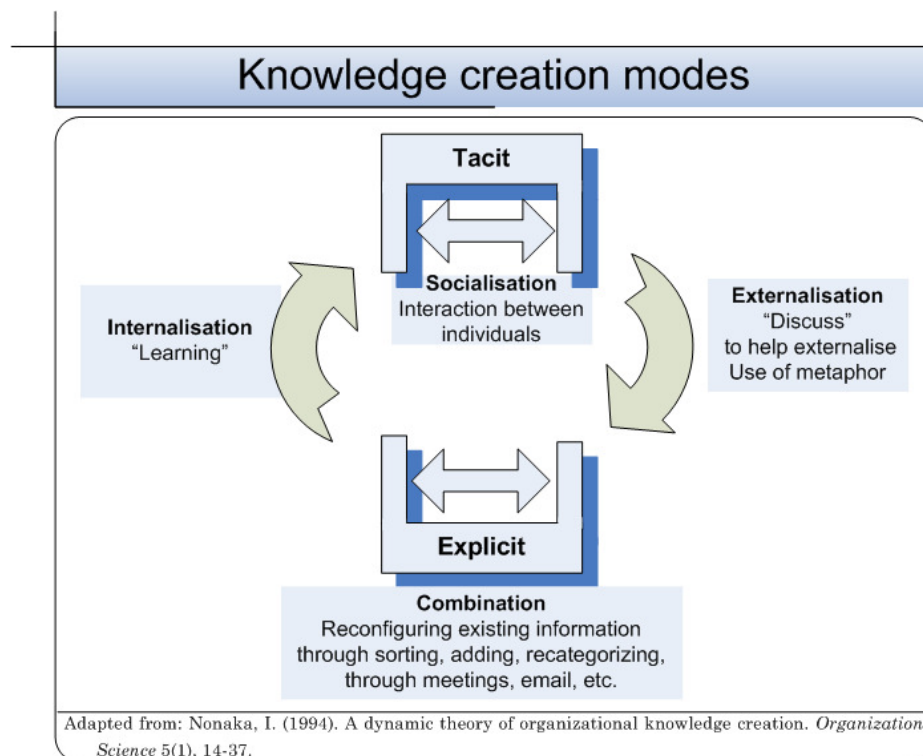


Figure 3-2: Knowledge creation modes

This supports the previous quote by Meisenberger and Seiwald (2002), that “*most knowledge is socially derived*”. An extension to the Vygotskian model



of group knowledge was discussed by Lewis (2002, p.8), where he concluded that in a community of humans, when the zopeds (areas surrounding individuals' core knowledge) overlap then the collective core of knowledge is greater than the sum of the individual knowledge, and that each person can support cognitive development in the group by providing 'scaffolding' to the others. That is, groups can contribute significantly in the collection of knowledge, and indeed groups are able to gather and synthesise information and knowledge more quickly than an individual.

### **3.2.3 Context**

For maintaining relevancy and accuracy of data, information and knowledge need to be managed in context. Patton (2002) stated that when we say to someone, "you've taken my comment out of context," this is effectively saying, "you have distorted what I said, changed its meaning by omitting critical context".

Lawrence-Lightfoot (cited in Patton, 2002, p. 63) defined context as "*setting-physical, geographic, temporal, historical, cultural, aesthetic – within which the action takes place. Context becomes the framework, the reference point, the map, the ecological sphere; it is used to place people and action in time and space and a resource for understanding what they say and do*".

Chanana, Ginige and Murugesan (2004) stated it has been argued that exploiting the user's context has the potential to improve the performance of information retrieval systems. Context can reduce ambiguity by associating meanings with request terms and thus limit the scope of the possible interpretations of query terms. Thus, a context-based information retrieval framework provides a foundation for an effective information retrieval system. Different notions of context have been used in information retrieval systems. For instance, context could be used to identify and interpret the user's physical environment, the user's current task, user's profile or information categories.

### **3.2.4 The value of shared contextualized knowledge acquisition**

In the chapter titled “knowledge is power”, Davidson and Voss (2002, p. 19) stated that “*company wealth has precious little to do with the physical assets they own and almost everything to do with the people*” and illustrate this with many examples. This view is supported by Drucker (1993 cited in Beazley, Harden & Boenish, 2002, p. 17) , who wrote that “*the basic economic resource is no longer capital, nor natural resources, nor ‘labor’. It is and will be knowledge*”. Stated differently the real value in an organisation is in the knowledge of its employees or their know-how, and is often stored in the head of the employee or as a side note (annotation) in a personal manual or folder. This documentation needs to be on-going rather than "frozen" and needs to incorporate real experiences and solutions.

Marks, Polak, McCoy and Galletta (2008) stated that a knowledge management system can improve an organisations responsiveness and effectiveness by preventing members from having to repeatedly solve the same problems.

Bush and Tiwana (2005) addressed the issue of how to design effective knowledge networks, and like Davidson and Voss (2002) state that “much of any organisation’s experience and expertise remains underused and underexploited simply because it resides not in databases, repositories, or manuals but in the minds of its employees”. In an educational context, classroom/lecture delivery is fundamentally a sharing exercise (or should be). Discussion usually takes place in a moderated environment where the topic is confined, and guidance and direction is provided by the facilitator.

When this is transferred to an online setting, learning often becomes individualistic and lacks social and personal interaction. Email and bulletin boards are used to overcome this but often lose the context of the knowledge, so the problem is how to capture this knowledge while maintaining the

context. This can be stated as a hypothesis as follows, “the cognitive learning of a student is enhanced when material is presented in an interactive mode, and the quality of the learning can be enhanced if the interaction can be kept in context and be directly associated with the content being studied.”

### **3.2.5 Knowledge networks**

Bush and Tiwana (2005) researched the users’ desire to continue using a knowledge network system, or the “stickiness”. Three key drivers of stickiness were traced: individual relationship, individual user reputation, and personalization. Relationship is the level of trust, respect, and closeness a user has with a peer group. Reputation refers to the extent to which a user is considered valuable by peer users. Personalization is the customization of the system to an individual’s idiosyncratic preferences, and was divided into context personalization (how people customized their environment) and content personalization (e.g., applying filtering mechanisms to restrict content). Bush and Tiwana (2005) found that personalization only affects stickiness after the knowledge network has established itself. The authors identified three ways to increase stickiness: raising user awareness of the working relationships developed through using the system, implementing persistent reputation-tracking mechanisms, and carefully choosing the types of personalization capabilities to be given to users.

### **3.2.6 Pedagogical considerations: teaching and learning using web based technologies**

Wade and Power (1998) described many of the advantages that the World Wide Web (WWW) provides for courseware delivery, such as: the ability to overcome data and platform incompatibilities, provide a consistent interface and search facilities, and integration of multimedia and interactive content. This allows the educator to concentrate on pedagogical issues rather than the technical details.

Based on their research Wade and Power (1998) provided a list of general requirements for WWW based instructional design. These are as follows:

1. Material should support a range of sensory experiences incorporating interactivity and multimedia elements;
2. Simulation and experimentation should be supported;
3. Testing and evaluation should be supported;
4. Software should motivate the students;
5. Learning environment should support student cognitive structures, for example, periodic review;
6. Collaboration functionality should be provided;
7. A well designed human computer interface should be developed;
8. Technical difficulties need to be minimized, for example, creating log-ins; and
9. Courses should have a logical structure.

Hiltz and Turoff (2005) identified the pedagogical concepts in f2f and online/hybrid courses as follows: f2f being objectivist and teacher-centred; and online and hybrid (or blended) courses using digital technologies such as constructivist, collaborative, and student-centred. They also identified that prior research showed that 10% to 20% of students always prefer f2f and believe they learn best in that environment, indicating there will always be a need for this style of learning. The importance of providing context and structure was highlighted by the comment that “much of what we do as educators is devoted to conveying to the student the cognitive maps that we use for problem solving in a discipline”.

McMahon (1997) identified social constructivism as a paradigm for learning on the WWW, and discussed the continuum from behaviourism, cognitive theory, and constructivism to social constructivism. There is a considerable amount of literature and research available on constructivism, for example, Ryder (2008) provides a comprehensive directory.

Cognitive loading, and the possibility of providing an adaptive interface should also be considered, and need to be generalised to other settings to determine if the same systems can be adapted to a different environment. Cognitive load can be assisted by displaying usage as footprints or breadcrumbs are a way to show where users have been (Nielsen, 1990), and can be used to highlight important information, and to simplify navigation within otherwise confusing hypertext environment (Mertens, Schneider, Müller, & Vornberger, 2004).

With the trend to personalization and connections on the Internet, this needs to be considered in an online teaching and learning system. A pedagogical framework for implementing social software tools can be developed by drawing on concepts from research areas such as: constructivism (Bruner, 1966; Piaget, 1973), social constructivism (Vygotsky, 1978), communities of practice (Wenger, n.d.), and a conversational model of learning (Laurillard, 2001).

Pioneered by theorists such as Vygotsky, **social constructivism** stresses the need for collaboration amongst learners in direct contradiction to traditional competitive approaches. As mentioned earlier, based on Vygotsky's work, Lewis (2002) concluded that in a community of humans, when the zopedes (areas surrounding individuals core knowledge) overlap then the collective core of knowledge is greater than the sum of the individual knowledge, and that each person can support cognitive development in the group by providing 'scaffolding' to the others.

McMahon (1997) described the importance of social constructivism in a web environment as follows:

*"One Vygotskian notion, that has significant implications for peer collaboration, is that of the 'Zone of Proximal Development.' Defined as 'the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in*

*collaboration with more capable peers" (Vygotsky, 1978), it differs from the fixed biological nature of Piaget's stages of development. Through a process of 'scaffolding' a learner can be extended beyond the limitations of physical maturation to the extent that the 'the development process lags behind the learning process' (Vygotsky, 1978). This has significant implications for the Web as a communications medium.. (as).. the Web has strong potential for social interactivity"*

An emerging theory is **communal constructivism**. Holmes, Tangney, FitzGibbon, Savage, and Meehan (2001) defined the term as meaning "an approach to learning in which students not only construct their own knowledge (constructivism) as a result of interacting with their environment (social constructivism), but are also actively engaged in the process of constructing knowledge for their learning community."

### **3.2.7 Seven principles of teaching delivery good practice**

Not only does consideration need to be given to the different student learning styles, but also to the factors that would be considered good practice in teaching delivery. Chickering and Gamson (1987) analysed good practice in undergraduate education and developed seven principles, that are a popular framework for evaluating teaching in traditional, face-to-face courses (Graham, Cagiltay, Lim, Craner & Duffy, 2001). Good practice:

1. encourages contacts between students and faculty;
2. develops reciprocity and cooperation among students;
3. uses active learning techniques;
4. gives prompt feedback;
5. emphasizes time on task;
6. communicates high expectations; and
7. respects diverse talents and ways of learning.

The challenge is to design an environment that blends f2f with online technologies, taking into account collaborative learning and including the principles of good practice in teaching delivery.

Chickering and Ehrmann (1996) described appropriate ways to use computers, video, and telecommunications technologies to advance them. Graham et al. (2001) use the principles as a “lens” for evaluating online courses. Discussion related to matching online teaching to the seven principles that are relevant to this research include:

1. *Encourages contacts between students and faculty.* Communication technologies enable increased student access to faculty members, and can be used to encourage communication between shy students, those who cannot regularly attend classes, or those who may not be comfortable discussing an issue in f2f (Chickering & Ehrmann, 1996). An issue is that instructors can be overwhelmed by email messages and bulletin board postings, and must provide reasonable response to student questions. Policies and standards were proposed to address these issues (Graham et al., 2001).
2. *Develops reciprocity and cooperation among students.* Increased opportunities for communication can strengthen study groups, collaborative learning, group problem solving and assignment discussion (Chickering & Ehrmann, 1996). Graham et al. (2001) found that the quality of student interaction was often “shallow”, so suggested guidelines for students and staff intervention.
3. *Uses active learning techniques.* Chickering and Ehrmann (1996) suggested that “the range of technologies that encourage active learning is staggering” and identified three categories of online tools: tools and resources for learning by doing, time-delayed exchange, and real-time conversation. Graham et al. (2001) identified that students should be able to present their work online, to enable them to learn from each other as well as the instructor.

4. *Gives prompt feedback.* Use of technologies such as email can provide person-to-person feedback, and can keep track of student efforts to show gains in knowledge or other valued outcomes (Chickering & Ehrmann, 1996). Graham et al. (2001) identified that instructors provide two types of feedback: information feedback and acknowledgement feedback.
5. *Emphasizes time on task.* Technology can dramatically improve time on task by making studying more efficient, for example, can reduce travel time, allows work and research to be done at home (Chickering & Ehrmann, 1996).
6. *Communicates high expectations.* Chickering and Ehrmann (1996) identified that “new technologies can communicate high expectations explicitly and efficiently” and “students feel stimulated by knowing their finished work will be ‘published’ on the World Wide Web”. Graham et al. (2001) suggested that technologies can provide challenging tasks, sample cases, and mechanisms to praise quality work, and that they can communicate high expectations by providing examples or models for students to follow.
7. *Respects diverse talents and ways of learning.* Chickering and Ehrmann (1996) identified that computer based technologies are capable of providing instruction using many different methods, such as, powerful visuals, well-organised print, ability to encourage collaboration, supply structure or leave content open-ended, allow students to work at their own pace, be free of time and place.



### **3.3 Mechanisms for acquisition, management and dissemination of information and knowledge**

#### **3.3.1 Acquisition**

Identifying that knowledge acquisition is “*socially derived*” (Meisenberger & Seiwald, 2002) or a two-way process creates opportunities for collecting the knowledge. The goal for this research has been to develop a model that allowed knowledge transfer in many directions, lecturer to student, student to student and ultimately student to lecturer. Indeed generalizing the model should enable multi-way knowledge sharing which is what occurs naturally.

A system designed for the acquisition of data, information and knowledge should be able to handle the three knowledge types identified by Davidson and Voss (2002): tacit (implicit), explicit, and missing.

The question then becomes, *can a model be developed that more closely simulates what actually occurs in a social-human sense, where knowledge is "what we know", and is "what we share"?* To be able to create such a model requires a system that is accessible to all, can be structured in a way that the data integrity can be managed and uses technologies that are readily available. The Internet provides us with a way to test the model, with techniques including sending emails, participating in discussion lists, contributing to wikis, to name a few.

Many terms have become associated with the Internet's size, such as, "islands of data" (Wade & Power, 1998), "lost in hyperspace" (Edwards & Hardman, 1999; Theng, Jones, & Thimbleby, 1996), "drowning in a sea of data" and more recently “to Googlise” (Cass, 2004; Urban dictionary, n.d.). Many terms point to the sheer volume of information and the web has been described as "a huge library where all the books are strewn on the floor". Hence, organising knowledge in domain repositories provides vast amounts

of information, but very little in the way of assistance to the visitor or researcher. Research via a search engine will often produce content that is delivered out of context. For example, an image from one site may be used to illustrate a different context in another. Other common web technologies, such as email can contain requests for assistance and refer to specific content, but manual alignment is necessary in order to match the content and context.

What kinds of systems have been developed to capture and retain knowledge? In very early times, images were drawn on cave walls. In some cultures, such as the New Zealand Maori, genealogical knowledge (wakapapa) was entrusted to the memory of selected individuals in a tribe (Reese & Colombo, 2005). Knowledge that has been written down has been around since ancient history, and indeed a book is an important way in which knowledge is retained.

Intelligent computer based systems require content to be structured in a way that is useful to a user, but is also capable of being analysed by a computer. In such a system, the data must be able to be captured and extracted in context. An electronic knowledge acquisition and dissemination system needs to provide tools and mechanisms that allow a user to not only acquire their own knowledge but to increase their knowledge.

### **3.3.2 Resource acquisition, management and sharing at source**

The internet is a multimedia rich environment, and a major objective for this research was to produce a metadata structure suitable to describe diverse data types. In the V/2-Online prototype the foundations for a multimedia object (MMO) and associated metadata language, called Media Vocabulary Markup Language (MVML) were developed. The background to the MMO and MVML will be discussed in chapters that follow.

In this thesis the problem statement associated with the resource acquisition, management and sharing at source is as follows:

*“What features are desirable in an electronic digital asset model that has the ability to retain context while transferring the content from one person to another and from one place to another?” (Chapter 1, Table 1)*

Key issues associated with this problem statement include: digital assets, bibliographic management, metadata, learning objects, organizing content, semantic web, user centred web, security and privacy; and uniqueness.

### **3.3.2.1 Digital assets**

Many systems have been developed to cope with the classification of paper based resources, and indeed this is the principal job of a library. Historically, card systems, and now electronic files, are used to contain the metadata that provide the link to a physical book or publication.

The term **digital asset** is used to describe a computer file containing “unstructured” data, such as text, an image, a video or audio clip, or “structured” data such as a document (typically containing text and images though it is possible to include animations, sound and video), a spreadsheet, or a database that has been tagged with descriptive information (Ziffdavis, 2003), and was first classified in the late 1990s (Natu & Mendonca, 2003). Typically the descriptive information is in the form of metadata that is in some way attached to the electronic artefact.

Much work has been done in this area, with the Dublin Core (2008a) metadata scheme being the most significant (Sokvitne, 2000), and the Dublin Core Metadata Initiative (DCMI) Metadata Element Set registered as International Standards Organization (ISO) standard 15836 (<http://dublincore.org/about/>). Essentially, the Dublin Core is a set of 15 optional fields such as title and author. Many electronic systems store the

metadata as a record in a database while the object that record describes is either a physical resource or accessed via a link.

Who creates the metadata is the subject of much debate. McGreal and Roberts (2001) defined two camps for capturing metadata in the context of learning objects. "The "internal reference" camp believes that the creators of learning objects should input their own metadata, while the "external reference" camp believes that only librarians or information specialists should input the data. The "external" camp argues that only professionals can ensure the integrity of the data that is input, while the "internal" camp argues that the number of learning objects is growing so rapidly that creating the metadata by professionals is simply too much work and would be very expensive."

A significant problem facing a content developer is the wide array of media types, competing standards and necessity to add new components and plug-ins to take advantage of them. Multiple electronic media types, such as unstructured (e.g. text, images, animation, audio, video) and structured (e.g. PDF, PowerPoint, Flash) are a significant problem for digital library systems both for storage, including long term storage (Rothenberg, 1995), and retrieval. Lorie (2001) identified that "*the technical challenge is to ensure that the information, generated today, can survive long term changes in storage media, devices and data formats*" (p. 346). Gladney (2006) indicated that in a digital collection "*content represented with relatively simple and widely known data formats can be saved more or less as is*" (p. 114), but how can all formats including those more complex formats be handled in a common and consistent way? This research considers some of these issues.

While various standards are emerging for different element types, many changes continue to happen. For example, a file format that allows both html and associated objects (such as images) to be embedded in a single file, is the Multipurpose Internet Mail Extension HTML (MHTML) file type

(extension mht), which was included in Internet Explorer 7, released in mid 2006. All relative links in the Web page are remapped and the embedded content is included in the .MHT file. The absolute references or hyperlinks on the Web page remain unchanged and the .MHT file is viewed using Internet Explorer. It should be noted, that this file type has the capability to become infected with a virus (Computer Knowledge, 2005).

Microsoft redefined their office suite program file formats in 2006 and Lasky (2006) reported that in PowerPoint 12 a single slide containing a photo and graphics that took up 5MB in PowerPoint 2003 shrank to about 0.6MB in the new XML based pptx format.

### **3.3.2.1.1    *Digital assets and metadata***

Metadata attached to a digital asset can be internal or external. A good example of externally created metadata is in the ACM digital library. In the ACM digital library, this metadata can be displayed in BibTex (Heitfield, 1996), EndNote or ACM Ref formats (Figure 3-3).

A digital asset can occur in a variety of formats and some repositories provide alternative formats. As an example, the online journal, Learning Inquiry (SpringerLink, 2007) demonstrates the use of multiple formats and associated metadata. The individual chapters are available in pdf or html. Digital rights are managed by a separate entity referred to as the RightsLink.

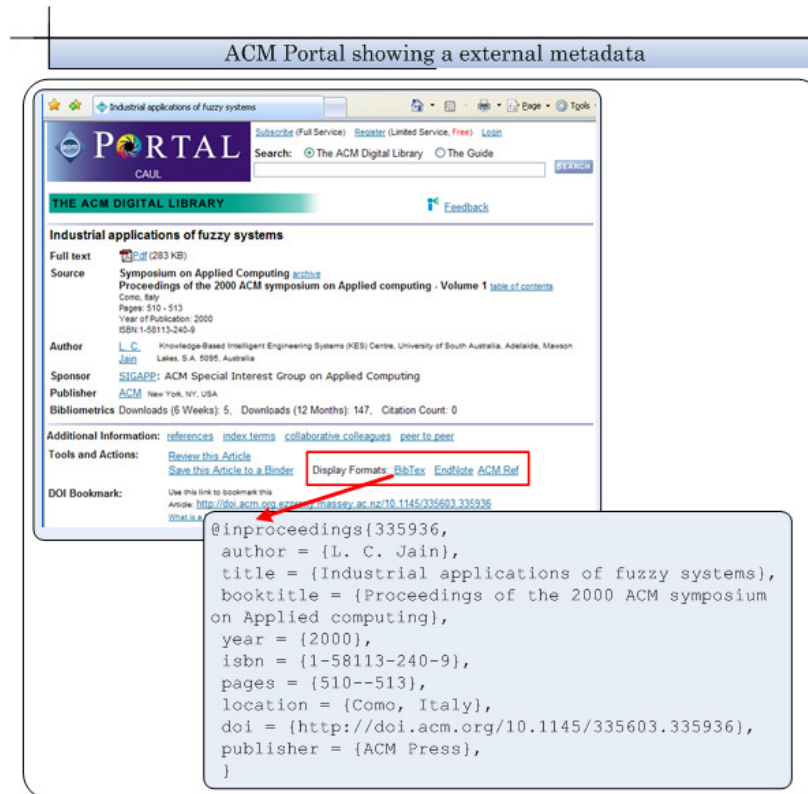


Figure 3-3: ACM Portal showing a external metadata

So a question that needed to be addressed is "can we describe resources in a common way so as to allow for clear referencing, content description and ownership?".

### 3.3.2.2 Bibliographic management

How can bibliographic material be referenced? Products such as the Microsoft Word add-in EndNote (2008) provide some of the facilities especially in the area of both inline and bibliographic referencing. CiteSeer (CiteSeer.IST, n. d.), a public scientific and academic search engine uses BibTex format to describe a documents metadata.

The library database ProQuest allows six referencing styles and maintains associated metadata in its own format. Additionally databases such as ProQuest, ACM and the ISI Web of Science library database provide the ability to hyperlink to other papers by the author(s) and cited references when available.

CiteULike (<http://www.citeulike.org>) is a free service that helps store, organize and share the scholarly papers. When a paper of interest is seen on the Web, clicking a button will add it to your personal library, with citation details automatically extracted, (Cameron, n. d.). The two referencing schemes supported are EndNote and BibTex.

Hence, it has been prudent for this research to cater for BibTeX and EndNotes when developing the metadata schema.

### **3.3.2.3 Metadata**

To enable resources, whether electronic or physical, to be usable in a Content Management System (CMS), metadata needs to be created. In the prototypes developed for this research, bibliographic, multimedia and glossary resource types were identified.

As mentioned earlier, any metadata needs to conform to current practice and standards. Standards relevant to this research are as follows:

- eXtensible Markup Language (XML) has rapidly gained momentum as the future of the internet, and indeed is the cornerstone of the Semantic Web.
- Dublin Core (2008a) is probably the most widely used metadata standard and co-exists with other metadata sets (McGreal & Roberts, 2001).
- Resource Definition Framework (RDF) is the W3C standard for encoding knowledge (Tauberer, 2006) which is essentially a way to uniquely identify a resource whether electronic or not.
- vCard is a metadata format that enables a person to be described. This is used extensively in commercial email systems and can be thought of as an electronic business card.

Including these metadata standards into a common schema increases the complexity. So, finding a way to make entry of the metadata by end user as

simple as possible was essential to give any proposed model any chance of success.

Two forms of metadata can be associated with a media resource, **derived** and **annotated**.

- *Derived metadata* is the data that can be extracted from the resource, such as, filename and file size, but varies greatly between various multimedia elements (Wotsit, 2008).
- *Annotated metadata* is the data added to the resource and to be useful, needs to be structured, be contextualized and contain meaning, which is also required by the Semantic Web (Goldfarb & Prescod, 2002, p. 653). For example, an image description should be described sufficiently enough that it could be imagined by a blind person.

DSpace (<http://www.dspace.org/>) is an open source software application used for accessing, managing and preserving scholarly works in a digital repository. The Dspace metadata schema (Tansley, Bass, Branschofsky, Carpenter, McClellan, & Stuve, 2007) categorises its metadata as descriptive, administrative and structural.

- *Descriptive metadata* includes attributes such as title, creator, date, publisher, and in the case of DSpace uses a qualified Dublin Core metadata schema loosely based on the Library Application Profile (Clayphan, & Guenther, 2004) set of elements and qualifiers which are provided by default. DSpace also comes pre-configured with the set of elements and qualifiers used by MIT Libraries.
- *Administrative metadata* includes preservation metadata, provenance and authorization policy data. Provenance metadata is stored in Dublin Core records.
- *Structural metadata* includes information about how to present an item, or bitstreams within an item, to an end-user, and the



relationships between constituent parts of the item. For example, in a thesis where each page is saved as a TIFF file, structural metadata would identify that each image is a single page, and record the order.

A criticism levelled at metadata is the need for considerable human input (Phillips, 2000, p. 494). This could be streamlined if some metadata could be inherited. For example, when creating a resource, a template metadata file containing say, core keywords, author's details, and so on could be used.

Adding metadata to files and creating sharable resources raises many issues, and Campbell (2003) identified many of these in relation to Learning Objects. Issues that are relevant to this research are as follows:

- Metadata creation requires manual input by an individual or group, and unless there are real benefits this will not occur (Phillips, 2000, p. 494; Goldfarb & Prescod, 2002).
- Malicious metadata, for example, a pornographic web site provider often adds fictitious metadata.
- Resource uniqueness, for example, two authors can create resources with the same name.
- The length of time the resource will last.
- Rights management and copyright.
- File management issues including versioning, moving and copying.
- Multi-lingual facilities, which are illustrated by Phillips (2000, pp. 496-497) for the Dublin Core in Danish and Arabic.

There is ongoing research in this area, for example, Xerox revealed that it had developed software that categorizes text and images at the same time (Xerox, 2007). With the proliferation of digital content, many documents contain both visual and textual information, and categorization technology has focused principally on either one or the other. In a comment on why it matters, it was indicated that smarter ways to categorize information will improve search, help businesses operate more efficiently, and create more effective documents (Xerox, 2007).

Researchers from the Massachusetts Institute of Technology (MIT) are working on using speech recognition software to annotate more than 200 video recordings of lectures to make them searchable by students. The importance of this is reported as "because there is no way to easily scan audio, as you can with printed text, you end up watching the whole thing, and it's hard to keep focused" (Trafton, 2007).

In another project, researchers from Pennsylvania State University were reported as having developed a software system termed tagging over time (T/T Technology) that not only automatically tags images as they are uploaded, but also improves those tags by "learning" from users' interactions with the system. A list containing keywords are presented to the user and the list modifies based on recent selections (Datta, Joshi, Li, & Wang, 2007).

### **3.3.2.3.1    *Usage and online metadata***

In the V/2-Online prototype developed in this research, usage data was automatically collected by the system, such as the number of times a snippet was visited. This can be considered metadata to objects in the system, such as a snippet. Ramakrishnan and Tomkins (2007, p. 66) identified that online metadata can typically be generated from four key forms:

- *anchor text*, by tracking hyperlinks;
- *tags*, by identifying single words or short phrases that are placed on a resource such as a picture;
- *page views*, by recording the number of times a page is visited; and
- *reviews/comments* by identifying free-form text associated with a resource.

Ramakrishnan and Tomkins (2007, p. 67) further identified four types of metadata that can apply to objects on the internet:

- *stars*, a rating scale ( ☆ ☆ ☆ ☆ ☆ );
- *tags*, or short textual words or phrases;
- *attention*, where a user has interacted with the object; and
- *text*, an associated review or comment.

This STAT (stars, tags, attention and text) metadata in many cases can be generated automatically through a search engine, or may be entered in real time by users. The authors indicated that they expected to see significant work combining this STAT metadata with user reputation measures to produce overall scores of object quality in various contexts.

### **3.3.2.3.2 Extensible Markup Language (XML)**

Extensible Markup Language (XML) has become a standard way to represent data structures on the Internet, and is incorporated into many applications. An XML file is a text file containing tags that describe the contents. Microsoft uses an XML format in Office 2007 replacing the binary proprietary format from earlier versions (Microsoft, 2008). Sun Microsystems' Open Office uses OASIS OpenDocument/ISO/IEC 26300 File Format (ODF) as its native file format (Brauer, & Schubert, n. d.). A downside of XML is the considerable size of the file, and to combat this, companies such as Microsoft and Sun compress the files into a zip archive.

XML also incorporates other technologies that will be useful in the development of a digital asset metadata schema. Once described in XML, extensible stylesheet language transformations (XSLT) can be used to convert the metadata to a variety of other XML formats such as Dublin Core, vCard and EndNote, and to produce a reference in a desired style such as APA. The XML structure can be described using Document Type Definitions (DTDs) although XML Schema is more desirable (Phillips, 2000, p. 147; Goldfarb, 2002).

### **3.3.2.3.3 Metadata standards**

*It is expected that other communities of metadata experts will create and administer additional metadata sets, specialized to the needs of their communities.*

– Diane Hillman (Hillman, 2005a, section 1.2)

There is much work in developing metadata standards, and many exist, so it is important, that any proposed metadata structure is consistent with existing standards.

### **3.3.2.3.4 Dublin Core**

Probably the most universally applied metadata schema is the **Dublin Core**, and this standard forms the foundation for many other metadata schemas used in Libraries. McGreal and Roberts (2001) describe the Dublin Core as follows: *“The Dublin Core has been described as the most broadly based metadata specification. It coexists comfortably with the other metadata sets and all its elements are optional and syntax independent”*. Like the other specifications, it can be tagged in HTML, raw XML or RDF/XML. It is a metadata schema commonly used by both digital assets and learning objects, and schemas that are based on Dublin Core include AGLS, EAD, GILS, IEEE LOM, IMS, INDECS, MARC, METS, MODS, ONIX, and SCORM (Woodley, Clement, & Winn, 2005).

Hillman (2005a, section 1.2) described the Dublin Core as follows:

*“The Dublin Core standard includes two levels: **Simple, and Qualified**. Simple Dublin Core comprises fifteen elements. Qualified Dublin Core includes an additional element, Audience, as well as a group of element refinements (also called qualifiers) that refine the semantics of the elements in ways that may be useful in resource discovery. The semantics of Dublin Core have been established by an*

*international, cross-disciplinary group of professionals from librarianship, computer science, text encoding, the museum community, and other related fields of scholarship and practice."*

Two important principles that are the basis of Dublin Core are the *one-to-one* principle and the *dumb-down* principle (Hillman, 2005a, section 1.2). In the one-to-one principle the Dublin Core metadata file is used to describe a single manifestation of an object. The dumb-down principle allows a reader to ignore any qualifier that has been included in the metadata file that is not part of the standard. Dublin Core can be represented in XML and the Resource Definition Framework (RDF), and exemplars are provided on the Dublin Core web site (Kokkelink & Schwänzl, 2002; Nilsson, Powell, Johnston, & Naeve, 2008).

Could Dublin Core provide a suitable schema for the framework? All elements in Dublin Core are optional, so while it provides an important basis, it has insufficient structured data to produce a standard APA style reference, a business card or structured rights information. The use of an extension to the Dublin Core, called the qualified Dublin Core, and represented by the tag `dcterms:BibliographicCitation` is a possibility, but this is a single field with no inbuilt structure. This has been addressed in part through the Library Application Profile (Clayphan & Guenther, 2004) which defines mandatory fields and an extension to the bibliographic citation using the OpenURL Framework (Apps, 2005). A lack of structure in the creator and non-XML structure for OpenURL were not consistent with the overall design goals proposed. Further, Dublin Core is designed to describe a single manifestation, referred to as the one-to-one principle (Hillman, 2005a).

### **3.3.2.3.4.1 vCard**

**vCard** is an electronic business card profile defined by RFC 2426, and is used extensively in email systems. While the original vCard metadata is described in its own notation, Ianella (2001) has described vCard in terms of

XML and RDF and it is usually referred to as xCard. vCard is a useful standard to adopt to describe the creator of a digital asset, but as a complete digital asset it is fundamentally designed to represent a business card. It should be noted though, that it does have the capacity to manage an alternative photographic representation.

Heath, McArthur, McClelland, and Vetter (2005) described the iLumina digital Library project in which their metadata schema is based on Dublin Core, IEEE-Learning Object Metadata (LOM). LOM currently uses vCard to represent author information which was found to be a liability for iLumina, so xCard was chosen for the iLumina schema.

#### **3.3.2.3.4.2 EndNote**

**EndNote** is an add-in to Microsoft Word that is used by millions of researchers, scholarly writers, students, and librarians to search online bibliographic databases, organize their references, images and PDFs in any language, and create bibliographies and figure lists (EndNote, 2008). Based on its metadata schema it is able to represent bibliographic data in a wide variety of formats, with EndNote X1 supporting more than 2,800 predefined styles (EndNote, 2008). The ability to export the digital asset into EndNote would be a useful and desirable feature for any metadata attached to a digital asset.

#### **3.3.2.3.4.3 MPEG-21, METS, and RAMLET**

Other metadata schemas considered included: MPEG-21, METS, and RAMLET. **MPEG-21** can be described as defining the technology needed to support users to exchange, access, consume, trade and otherwise manipulate *digital items* in an efficient, transparent and interoperable way (Bormans & Hill, 2002). Bormans & Hill (2002) also describe the MPEG-21 Digital Item Declaration (DID) specification, which is similar to the MMO/MVML. The MPEG (Motion Picture Experts Group) file format is principally a motion picture format, and as such deals mainly with audio

and video data. MMO/MVML and MPEG-21 are both designed to work with multiple data types, though MPEG-21 will be encapsulated in its own proprietary file format, and at this stage is not used in industry. Unfortunately, as noted by Mercuri (2003), when using MPEG, a person "runs the risk of copyright or patent violations", and that "even independent implementation requires negotiation with patent holders who have contributed technology to the standard". She further indicated that the standard is owned by the International Organisation for Standardization, and "it requires that all the technology within MPEG be licensable by its contributors on fair and equal terms". A further problem exists, in that a piece of specialized software (a player) is needed to access the data contained within the MPEG file. This requires the MPEG player to be constantly updated as new formats are introduced, or to have a significant number of decoders attached for legacy file formats.

**Metadata Encoding & Transmission Standard (METS)** (Library of Congress, 2006) is a digital asset metadata format proposed by the US Library of Congress, and in many ways has similar goals to the digital asset metadata. METS is a standard for encoding descriptive, administrative, and structural metadata regarding objects within a digital library. It is expressed using XML and includes the Dublin Core standard. One significant difference to the MMO is that METS is also an aggregation system that manages a structure, via a structural map to define linkages and order. The goal of the MMO is a multiple representation of a single digital asset. Another shortfall of METS is that it also lacks fields to enter context.

Institute of Electrical and Electronics Engineers (IEEE) Learning Technologies Standards Committee (LTSC) Computer Managed Instruction (CMI, 2005) defines a **resource aggregation model for learning, education, and training (RAMLET)**. The goals of RAMLET and the MMO are different, as RAMLET provides a mechanism for disassembly of a

resource and then re-aggregation whereas the MMO attempts to provide a multiple representation of a single resource.

### **3.3.2.4 Learning objects**

In the context of this research, which is a teaching and learning environment, content is often packaged as a learning object (LO). Literature defines LOs in a variety of ways, and includes resources that have no explicit learning outcome, persons, organizations, or events. Although not included in all definitions, the inclusion of pedagogy is commonly believed to be an essential part of an LO (DLNET, 2002; Mortimer, 2002; McGreal & Roberts, 2001).

The term learning object is grounded in an object-oriented paradigm and, as defined by the IEEE LTSC, is any entity, digital or non-digital, which can be used, re-used or referenced during technology-supported learning (Dray, 2005). DLNET (2002) defines an LO as a structured, standalone resource that encapsulates high quality information in a manner that facilitates learning and pedagogy. It has a stated objective, a designated audience, ownership, and associated intellectual property rights, so its content shall remain unchanged in the process of converting the resource into a learning object.

These definitions are very broad and include not only the computer-based components (multimedia content, instructional content, instructional software and software tools), but also people, places, things and ideas (Wiley, 2000). Indeed, there is debate as to what exactly is an LO. Unfortunately the flexibility of the LO definition also restricts its usefulness, especially when trying to allow for automatic structuring of domain content.

Mortimer (2002) describes an LO as follows; at its most basic level, an LO is a piece of content that's smaller than a course or lesson. But the LO does not exist in a vacuum; it is one of three interdependent components (Figure 3-4):



- the learning object itself ;
- metadata, or the standardized way to describe the content in code;  
and
- a learning content management system (LCMS) that stores, tracks,  
and delivers content.

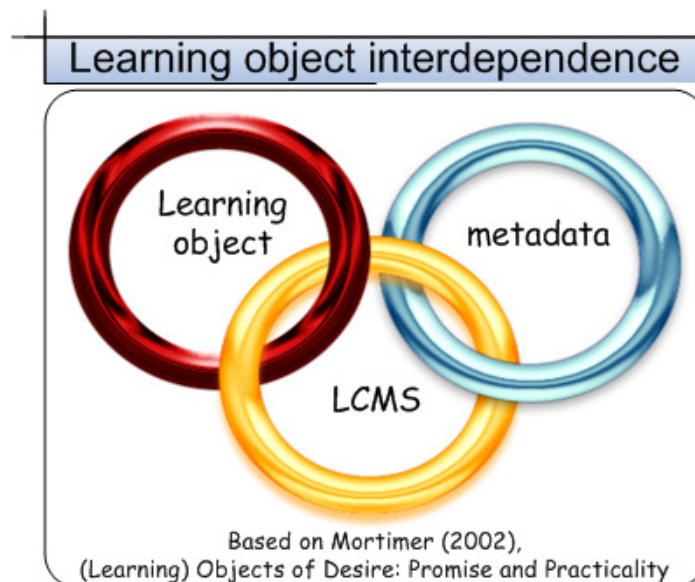


Figure 3-4: Learning object interdependence.

McGreal and Roberts (2001) classified LOs in terms of their level of granularity: *components*, *lessons*, *modules* or *programs*. That is, at its simplest level it could be a *component* (e.g., a simple text, a photograph, a video clip, a 3D image, a Java applet) or any other object that might be used for learning. Components could be attached to a *lesson*. Lessons could be grouped into *modules* and modules aggregated to *programs*.

The ability to reuse portions of content is a major area of research and development. Many Institutions, both academic (e.g., DLNET from Campus Alberta, University of Mauritius Learning Objects Repository (University of Mauritius, 2002), and IMS Common Cartridge (IMS GLC, 2007)) and commercial (e.g., Course Cartridges (Blackboard, 2008a)) have set up repositories to store and manage LOs.

Developing learning resources is a costly and time consuming process. In order to facilitate the sharing and management of content, there is considerable research in the construction and standardization of LO repositories (LOR) (McGreal & Roberts, 2001). IEEE LTSC (Dray, 2005) and Sharable Content Object Reference Model (SCORM) (ADL, 2006) compliancy is considered to be the current standard, although many countries are developing standards based on these, such as United Kingdom Learning Object Metadata (UK LOM) Core (JISC Cetis, n.d.) and the Canadian equivalent, Cancore (2006). Content packagers such as RELOAD (2004) evolved to allow manifests of files to be easily bundled together with learning object metadata. A survey by Verhaart (2004a) indicated that problems such as ownership have caused LORs to become metadata sites linked to personal content. This is a persuasive argument for developing a user centred framework for acquiring, managing and disseminating digital content.

A considerable amount of money is invested in content development, and the ability to develop collaboratively and share this content is possible using web technologies. LORs exist in a variety of forms.

- Content with limited linking, such as:
  - Curriki (n.d.). ; and
  - Learning Objects, Learning Activities (LOLA) (Wesleyan University, 2006).
- Links only (metadata repositories), such as:
  - or Multimedia Educational Resource for Learning and Online Teaching (MERLOT, 2008); and
  - Learning about learning objects (n.d.).
- Content plus links, such as:
  - ARIADNE (2006);
  - Commonwealth of Learning - Learning Object Repository (n.d.); and
  - The National Science Digital Library (NSLD, n.d.).

These may be implemented using a variety of proprietary or open source applications such as DSpace (n.d.) or Greenstone digital library software (2007)

The development of LOs has a direct relevance to resource acquisition, management and sharing at source, as many of the technologies, structures and issues are similar. In the analysis of the state of LORs Verhaart (2004a) concluded that LORs appeared to have developed into portals, pointing to web content and at the time it was often better to use a web search engine such as Google to find suitable teaching content.

So given that LORs are evolved into portals, this research proposes that the user centric model (virtualMe framework) managing an individual's knowledge portfolio was the next evolutionary phase to distributed knowledge sharing.

### **3.3.2.5 A review of relevant issues**

Other issues relevant to resource acquisition, management and sharing at source include the following: how content is organized, the semantic web, the evolution of a user centred web and Web 2.0, security and privacy, and global uniqueness.

#### **3.3.2.5.1 *Organising content***

Reviewing the literature into the ways information and knowledge can be organized reveals several technologies: the Semantic web (Frauenfelder, 2001), where meaning is being applied via metadata and its relationship to the area of ontology (different ways of viewing data), and taxonomy.

A taxonomy provides us with a way of ordering documents. The metadata provides a description of what the document is about, but it is the taxonomy that provides context. A familiar taxonomy is that of a book index, where subject areas are placed in order and this provides a reference point for a

book's contents. This can be referred to as a "backbone taxonomy" (Guarino & Welty, 2002) which consists of all the rigid properties of an ontology.

Hence, for each domain a backbone taxonomy is required to organise the snippets. Indeed, for the database to be functional the backbone taxonomy needs to be established before any snippets can be created.

### **3.3.2.5.2 Semantic Web**

Another important concept is that of the Semantic Web (W3C, 2008a), which is fundamentally about adding context and meaning to the Web content. Coyle (2008, May) described the Semantic Web as follows: *"The goal of the Semantic Web is to transform the Web into a web of data, rather than a web of documents. Web resources must cease to be undifferentiated strings of text; instead, they have to be able to reveal meaning within the text. Meaning, of course, in this case is: meaning that machines can process. To achieve this, the Semantic Web must create interactions between the ideas and facts in web resources."* Use of the structures suggested in this research is consistent with the Semantic Web (e.g., XML and RDF) and will enable media and multimedia objects to retain and maintain their original context even when used in many different contexts.

### **3.3.2.5.3 Evolution to a user centred web**

As Web technologies mature, paradigms are continually evolving and emerging, and in a teaching and learning context it is useful to consider these new directions to see how and if they can be integrated. As discussed previously, there is increasing interest in developing systems that are based on managing social structures centred on an individual (e.g., MySpace, BeBo, Blogs, and Wikis), and this is commonly referred to as Web 2.0 (O'Reilly, 2005).

Web content has also evolved from one where content is controlled by organizations to one where individualization and the collective intelligence

have become important. For example, encyclopaedia web sites (such as, Britannica, Encarta) are being replaced with user contributed Wikipedia, and indeed content accuracy rates are reportedly similar (Goodin, 2007 cited by Wojcik, 2007).

### **3.3.2.5.4 Uniqueness**

Since the Internet is a global platform an issue that arises is that objects should have a global uniqueness. Microsoft created unique identifiers for Active X Controls (Classid) (Yigdall & Strine, 1998), but these are complex in structure and use. The Web uses domain names and associated IP addresses to provide uniqueness (HowStuffWorks, 2008).

A potential research question is as follows: How can global uniqueness be achieved for snippet, bibliography and multimedia entities, without creating unnecessarily complex identifiers?

Lee, Kang, Mitra, Giles, and On (2007, p. 34) stated that “many of these problems (relating to uniqueness in bibliographic citations) can be solved through ‘global IDs,’ no matter how different two citations might seem; if both carry the same global ID, they are considered to be the same citation. Popular global IDs include ISBNs and digital object identifiers (DOIs)”.

The Digital Object Identifier (DOI) system attempts to address the issue of identifying electronic resources and is found in many digital libraries, such as ACM (Figure 3-3) and IEEE, and with publishers, such as Springer (<http://www.springer.com/>), and is included as part of the citation information. Over 33 million DOI names have been assigned in the US, Australasia, and Europe (DOI, 2008).

A metadata schema is described in the DOI Handbook (DOI, 2006, pp. 51-55), and identifies a kernel declaration that includes: DOI name, what the resource is commonly known by (e.g. ISBN), what it is usually called,

publisher/creator and their role, the structural type, how it is perceived, and the type of resource.

To incorporate the DOI into the proposed MMO would require adding the DOI identifier to the MVML specification. The requirement to register every digital asset in this way takes implementation of this beyond the scope of the research.

### **3.3.3 Annotations**

A further area to be investigated as part of this thesis is in the acquisition of information and knowledge from users and visitors, so in the context of a blended teaching and learning environment, how can information and knowledge be added by other people? The problem statement associated is as follows:

*“What features are desirable in a framework that would enable other people to add information and knowledge that will benefit all users of the system?” (Chapter 1, table 1)*

Key issues associated with this problem statement include: adding information and knowledge, in and out of context; why would this be useful; ways to add information and knowledge; and managing different media types.

#### **3.3.3.1 Adding information and knowledge**

The scope of following discussion will be confined to looking at electronic additions by visitors to a system based on the proposed framework.

As the core body of knowledge is the “property” of the owner, an appropriate way to manage visitor additions is via structured comments, and the term annotation can be used to describe such comments. Merriam-Webster dictionary (<http://www.m-w.com/dictionary/>) defines an annotation as “a note added by way of comment or explanation”, Lexico Publishing

(<http://dictionary.reference.com>) as “a critical or explanatory note or body of notes added to a text”, and Wikipedia (<http://en.wikipedia.org>) as “extra information associated with a particular point in a document or other piece of information”. The Compact Oxford dictionary (AskOxford, 2006) defines an annotation as “add explanatory notes to”. A search on definitions of annotation using Google (<http://www.google.com>), generally defines an annotation as a comment or summary attached to an existing content fragment, such as a web page, bibliography, or image.

Carter, Churchill, Denoue, Helfman, and Nelson (2004) state that "by annotations we mean comments, notes, explanations, or other types of external remarks that can be attached to any Web document or a selected part of the document without actually needing to touch the document."

In this thesis, an annotation will be defined as “a comment added to an online system by a visitor.”

### **3.3.3.2 Electronic Annotations**

Annotating content has become increasingly common on the Internet, allowing visitors of Web pages to add comments. For example, online newspaper articles (e.g., The New Zealand Herald, (Figure 3-5), <http://www.newsfactor.com>, <http://www.askmecorp.com/>) request feedback or discussion, and computer based tutorials (e.g., Adobe LiveDocs, Figure 3-5) ask for user comments to improve the quality of the material.

## Soliciting user comments on web pages

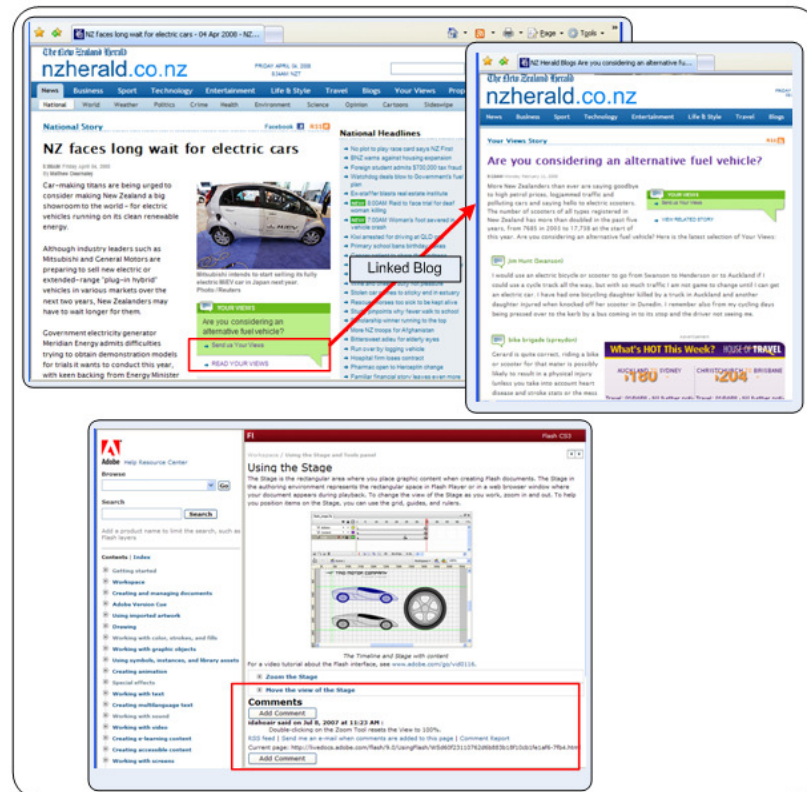


Figure 3-5: Soliciting user comments: NZ Herald (Dearnaley, 2008, April 4), and Adobe (2007) Flash CS LiveDocs

There are many ways in which electronic annotations can be made. An unstructured entry into a computer based knowledge system can occur using a variety of well known tools. Email, standalone bulletin boards and blogs are examples of systems allowing "out of context" annotations, and relating an email to the context often requires intensive manual or sophisticated computer matching. A bulletin board system allowing threaded responses is an example of a multi-level annotation system. A *Blog* or "weblog" (Cyber Business Centre, 2003; Winer, 2002) is an online diary or journal, typically documenting the day-to-day life of an individual, and has become a way in which individuals can record unstructured comments and allow reader annotations. This date-time structure can be adapted to allow for unstructured comments when used to record general comments in chronological order and structured when attached to existing content (Figure 3-5, NZ Herald).



Another annotation system is a wiki (Leuf & Cunningham, 2002), and in a wiki a visitor is capable of editing and modifying the actual content. First coined in 1995 by Ward Cunningham, wiki means quick in Hawaiian (Louridas, 2006). Cortese (2003) stated that a wiki is web collaboration software used by informal online groups, and is taking hold in the business realm. Both blog and wiki concepts are included in the proposed framework.

Likert scales and free form comment fields are other ways to comment on the usefulness of content (Figure 3-6).



Figure 3-6: Newsfactor (2007, November) showing a likert scale used to rate the article

New hardware devices are also providing opportunities to annotate. Marshall and Brush (2004) describe the use of annotations using tablet PCs and Carter, et al. (2004) describe public plasma posters. Marshall and Brush (2004) observed that “readers sometimes didn’t recognize their own annotations when they were taken out of context.”

Managing information and knowledge can be done using what has been described as a *web assistant system*, which can be defined as a user support component added to any kind of web information system (WIS) (Aberg & Shahmehri, 2001). An annotation system attached to an overall content management system would be considered a web assistant system.

### **3.3.3.3 Need for annotations**

Annotations provide a common and consistent method to add value to information and knowledge. In a paper based system annotations are commonly expressed as notes in a margin. In an electronic system annotations are added and linked to a content record in a database.

Bottoni, et al. (2004) indicate that “annotation supports different cognitive functions such as *remembering* – by highlighting the most significant parts of the annotated document, *thinking* – by adding one’s own ideas, critical remarks, questions, and *clarifying* – by reshaping the information contained in the document into one’s own verbal representations”.

Why is the facility to annotate important? Primarily, an annotation provides the ability for user comment on a particular piece of information, or to enhance that piece of information.

The ability to annotate electronically can be done in two ways: out of context, such as via email; or in context, such as commenting on a specific article.

### **3.3.3.4 Annotation types**

*Ma tou rou, me taku rou ka ora te iwi*

*(With your contribution and my contribution we will succeed.)*

- Maori Proverb

Email is an example of an **out of context annotation**, although it could be argued that using the "Reply" button and retaining the original email could be considered contextualized annotating.

Bulletin boards and mailing lists often allow **threaded annotations**, that is, the original comments can have annotations attached. Where a bulletin board maintains categories, postings within a category would be an annotation in-context as would any annotation attached as a thread.

Wikis (Leuf & Cunningham, 2002) are **in-line unstructured annotations**, where the original information can be edited. In order to cope with the possibility of malicious editing of a wiki page many systems maintain a copy of each iteration or a change log as the page is updated. A web log or blog (Winer, 2002), on the other hand, is a virtual diary, allowing for disjointed and chained annotations.

### **3.3.3.5 Context aware annotations**

Bulletin boards and email systems are commonly used to foster community knowledge, but they have one significant drawback. The discussion in these systems occurs within the context of the email or discussion board, so if a comment relates to something external, such as a suggestion to modify or alter content, then working out the relationship between the comment and the external content can be difficult and time consuming.

The capability of a system to keep the context of an annotation is essential to allow for intelligent extraction of the annotation's content. Many manufacturers have online systems that manage and maintain context aware annotations. For example, in Adobe LiveDocs (Figure 3-5) pages display user comments and include an "Add Comments" button.

Other computer based applications allow for electronic graphical and textual annotations. For example Sunnet's AniCam can capture a screen discussion which can include a web camera, and allows for annotations to be drawn

(Verhaart, 2003a). SMART Technologies' (2005) Smartboard allows for annotations to be added directly to a large surface whiteboard in a face-to-face classroom environment. Adobe's (2008) Captivate and TechSmith's (2008) Camtasia Studio capture on-screen interactivity and auto-annotate operations such as which option was clicked, plus allow for after-capture annotation. Some modern operating systems coupled with appropriate hardware, such as Windows XP Tablet PC Edition, are capable of context aware annotations.

The Annotea project (Koivunen, 2005) allows annotations to be added to web documents via web servers:

*"By annotations we mean comments, notes, explanations, or other types of external remarks that can be attached to any Web document or a selected part of the document without actually needing to touch the document. When the user gets the document he or she can also load the annotations attached to it from a selected annotation server or several servers and see what his peer group thinks. Similarly shared bookmarks can be attached to Web documents to help organize them under different topics, to easily find them later, to help find related material and to collaboratively filter bookmarked material."* (Koivunen, 2005)

An issue associated with visitor added annotations is the trueness factor, and if we look at f2f discussion, the facilitator acts as a truth moderator. If a false annotation is made to an online database should the annotation be removed, or annotated to indicate the error? In a learning environment debate should be fostered, whether the original annotation is assessed as false or true.

### **3.3.3.6 Multimedia annotations**

Typically annotations are textual and there are many advantages over other media formats such as: small size, translatable into other languages, searchable and so forth. The Microsoft Research Annotation System

(MRAS), (Grudin & Barger, 2005) is an example. With the continuous improvement in connection speeds and decreasing costs of storage, other forms of annotations need to be considered. Products such as Microsoft Word allow for audio annotations, and any computer based knowledge system would need to be able to manage multiple media formats. The challenge is to not only enable non-textual annotations but also provide mechanisms to allow for their efficient retrieval.

Some content systems, notably the Greenstone project (2007), have been working with technology that enables a tune to be found by humming part of it.

### **3.3.4 Personal Content Management frameworks**

In the pursuit of increasing personal knowledge, information is synthesised from many sources. Unfortunately, cognitive capabilities of humans vary greatly, and recalling stored information and knowledge can be challenging, so there are benefits in developing mechanisms that help store this information and knowledge in a way that provides easy retrieval. Techniques used may include keeping journals, making summaries, drawing concept maps, and so on.

The ubiquitous nature of the Internet combined with a rapid decline in storage costs has led to the use of the Internet as a place to store and share personal data. Google (<http://www.google.com>) recognized this trend in 2004 and introduced an email solution, Gmail with a huge storage capability for each user (by April 2008 over 6.5GB). The Microsoft Network (<http://www.msn.com>) and others have created communities where individuals can organize social sites containing a variety of personal information and discussion networks. Individuals have also been managing and maintaining public web sites (such as, <http://www.yahoo.com>) to share personal information.

There is increasing interest in developing systems that are based on managing social structures centred on an individual. The January 2006 issue of the Communications of the Association for Computing Machinery (CACM) featured Personal Information Management Systems which range from systems designed to capture everything that occurs in one's life "MyLifeBits" (Gemmell, Bell, & Lueder, 2006) to managing personal medical data to aid in future diagnosis (Pratt, Unruh, Civan, & Skeels, 2006).

Online systems such as MySpace (<http://www.myspace.com>) and BeBo (<http://www.bebo.com>) that are centred on an individual became popular over a very short space of time. Bebo, in the first 13 months, had more than 22 million members (Ward, 2006), and by November 2007, 39 million active users (Helft & Stone, 2007, Nov). By 2006, Myspace had attracted more than 54 million accounts (Associated Press, 2006), rising to 110 million active users by November 2007 (Helft & Stone, 2007, Nov). Facebook (<http://www.facebook.com>) had 7.5 million mostly college students (Spanbauer, Dec 2006/Jan 2007), rising to 51 million active users by November 2007, with an average of 200,000 new registrations per day since January 2007 (Facebook, 2007). The web site YouTube (<http://www.youtube.com>) allows individuals to post videos, Flickr (<http://www.flickr.com>) to share images, and authorSTREAM (<http://www.authorstream.com/>) PowerPoint slides. Blogs (or web logs) have gained popularity, and in November 2006, Technorati, a blog search engine, was tracking more than 57 million (BBC, 2006), and by April 2008, 112.8 million (Technorati, n.d.). Alongside this is the advancing integration of mobile technologies with text messaging, sound file sharing and podcasting.

Many of these systems form the backbone of Web 2.0 (O'Reilly, 2005), where "controlling your own data" is a central principle.

### **3.3.4.1 A background to Personal Content Management Systems**

In order to answer the question “can we create a personal content management framework, where an individual has the ability to create and share an electronic summary of their knowledge?”, it is useful to consider how personal content has been managed in the past.

Prior to the introduction of electronic content, material was delivered using a chalkboard to learner (and more recently whiteboards). Books were expensive, so an instructor would present material in “chalkboard” chunks and this method was the main delivery method throughout the 20<sup>th</sup> Century. With the emergence of personal computers in the early 1980s, several electronic technologies were developed. Word processors allowed textual data to be captured and stored electronically, and the photocopier, developed by Xerox allowed multiple copies of printed material. Presentation tools, such as Microsoft’s PowerPoint appeared, and coupled with projection pads mounted on top of an overhead projector enabled electronic presentation. The early 1990s saw the static Web emerge and the spread of accessible networks with reasonable performance. The growth of online content changed the way research was done as “knowledge” could be obtained quickly and easily from a computer connected to the Internet pretty much anywhere in the World. Web pages at the time were hard coded in hypertext markup language (HTML) and a significant time investment was required for authors that maintained static pages. For example, the researcher of this thesis built a static content web site to assist teaching delivery that had in excess of 4,000 html files and over 8,500 electronic media and multimedia files (Verhaart, 2000).

### **3.3.5 Learning /Content Management Systems**

Specialised commercial and open source management systems exist for large content repositories, for example HyperWave (2008), and tools are

available for researchers to assist in the construction of literature reviews, for example EndNote (2008), but a real gap exists in the ability of individuals to easily capture the knowledge from the source and manage their knowledge.

In an academic environment, systems such as Blackboard (<http://www.blackboard.com/us/index.Bb>) and Moodle (<http://moodle.org/>) provide an environment to store, manage and deliver courses and course content. While providing much functionality, a gap in these systems is in managing context from a teaching perspective, with content and student comments managed separately.

### **3.3.6 Existing systems**

Learning management systems such as Moodle and Blackboard provide comprehensive environments for teaching and learning, and include features for content delivery, student management plus areas for student collaboration, such as, discussion forums, group work, chat, virtual classrooms, and features which can promote individual student participation, such as, quizzes, wikis, and blogs (Blyth & Verhaart, 2007). Dougiamas (2000) developed Moodle as an open source alternative to Blackboard and claimed that Moodle uses constructionist referents to model the engagement of participants with course content and each other.

Fischman (2007) describes Classroom Presenter, designed for the classroom where students have computers on their desks with touch-sensitive screens that read pen strokes that allow them to raise a "virtual hand". In this system a slide on the teacher's computer is replicated on the students' computers. Students then annotate "their" copy, which can then be viewed as resizable icons by the teacher. Answers students submit are anonymous, which encourages classroom participation.



Ubiquitous Presenter (Fischman, 2007) extends Classroom Presenter and allows non-pen based tablet PCs to communicate, and uses check boxes as a feedback mechanism. Collaborative problem solving using blogging is possible with Ubiquitous Presenter, by assigning selected students to the “master” notes. As this happens in real time, the blog can be displayed on an overhead projector viewable by the class.

### **3.4 Conclusion**

There are many systems available that deliver content. There is an identifiable gap in the literature for an integrated information and knowledge framework centred on an individual, that takes advantage of web based technologies. The review also identified a significant area for research in digital asset management, where context and multiple representations are not well managed.

The following chapters will describe the findings from action research that has been done to identify what features are desirable in a framework that will manage an individual’s information and knowledge that would be useful for educators and their students in a blended teaching and learning environment.

## **4 Action research cycle one: static prototypes**

The problem this thesis addresses came out of a need to develop a teaching and learning environment that allowed for the acquisition, management and efficient sharing of content from and among both the educators and the students. As internet technologies evolved so too did prototype teaching and learning systems to support this research.

Three action research phases can be identified: developing an underlying framework through static prototypes, developing an interactive framework, and refining the interactive framework. This chapter describes the first phase where an underlying framework was developed.

This phase of the action research was conducted while Web technologies were emerging, and with the limited capabilities for interaction, structures necessary to deliver information and knowledge in an Internet environment were developed.

### **4.1 Methodology**

#### **Sample**

Existing teaching and learning content that was in an electronic format, and new content was used during this phase. The electronic content was initially used to support the teaching content in two multimedia papers in the National Diploma in Business Computing (NDBC) (Corich & Verhaart, 1996), and further papers in the NDBC replacement qualifications (Certificate in Business Computing (CBC) and Advanced CBC), as well as papers in the New Zealand Qualifications Authority (NZQA) Certificate in Computing (Verhaart, 1997; Verhaart 1998).

## **Procedures**

The static prototypes provided the background necessary to develop a framework that allowed for the acquisition of information and knowledge at source, and this chapter summarises the evolution, use and observations of the static prototypes.

## **Instruments**

During this early stage Web technologies evolved at an ever increasing rate, and a prototype instrument was used that cycled through: prototype design and implementation; usage to determine validity, feasibility and pedagogical suitability; and feedback through discussion with students and colleagues.

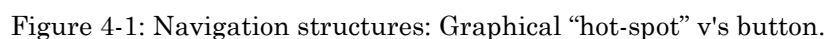
## **4.2 Initial development (1985-1995)**

Creating electronic documents in an affordable educational setting first became possible with the introduction of the IBM PC in 1980 and of word-processors such as WordPerfect and MS-Word in 1983 (Davis, 2003). By 1990 it was common to create teaching content in electronic documents. Printers were typically black and white using dot-matrix technology. Computer displays using 16 colours were common, enabling presentations to become visually appealing, and increased to 256 colours in the early 1990s. Electronic presentation software evolved in the late 1980s and version 2 of Microsoft's PowerPoint was released for Windows 3.0 in 1990 (Gaskins, 2007; Belleville, 2000).

Other technologies started to evolve in the early 1990s. With the evolution of electronic document handling, creating content in an easily redistributable format was investigated. At that time storage was expensive and of low capacity, files were commonly saved on a 1.44MB floppy disk, and a 40MB hard disk drive was considered huge. The ability to project computer images using a transparent liquid crystal display (LCD) pad or a

### 4.2.1 Windows Help files

In an attempt to provide a rich learning experience, students could choose to start from either a graphical or button navigation format (Figure 4-1).



For the graphical menu, links to content were found by moving the mouse over the image and locating “*hot spots*”, for example, information technology was linked to a picture on the wall. While navigating using the graphical image looks more attractive, finding all the “*hot spots*” proved to be difficult. Further, maintaining the picture was difficult since any change in the office graphic required regeneration of all the hotspots. Clicking on either the hotspot or button on the start page would branch to a "basic overview" of the topic.

After trying several different layout designs, a dual window layout was chosen, with one window containing an index and the other the associated text. Information could be searched quickly, and students found this easy to navigate.

Some drawbacks of the Windows Help files were identified, and these included:

- Poorly formatted pages, with large amounts of white space and small amounts of text, when students printed out the material (since the notes were designed for the computer screen). The solution, at the time, was to provide an equivalent word-processed document, which was reproduced as a handout for students. This led to duplication of effort, and problems in maintaining multiple copies of the same content.
- Relying on the availability of a projector. The solution at the time was to screen dump into a PowerPoint presentation. This created a large PowerPoint file, and required a double update (to the Windows Help file and PowerPoint file) each time an addition or change was made.

### **4.3 V/2-Encyclopedia Prototype I (1995 – 2000)**

The early 1990s saw the static Web emerge and the spread of readily accessible networks with reasonable performance. The growth of online content changed the way research was done as information and knowledge

could be obtained quickly and easily from a computer connected to the Internet pretty much anywhere in the World.

By 1996 work began in investigating the use of web technologies, and a paper by Corich and Verhaart (1996) looked at the migration of Help files to the then web browser Netscape Navigator, and a prototype developed by Verhaart coined the V/2-Encyclopedia was described.

The objectives that were explored to research the delivery of teaching materials using computer technology included the requirement to:

- enable rapid updating of the notes;
- enable the notes to be available from a centralised networked server thereby allowing the most up-to-date notes to be accessible by students;
- enable computer technology to assist in providing material for computer theory; and
- enable the students to access the material from their own personal computer.

The Web technologies that became available allowed for ideas to be prototyped, and these included: displaying content using hypertext mark-up language (HTML), including rich media (including animation, sound and video), adding interactivity, and adding forms.

### 4.3.1 Displaying content in HTML

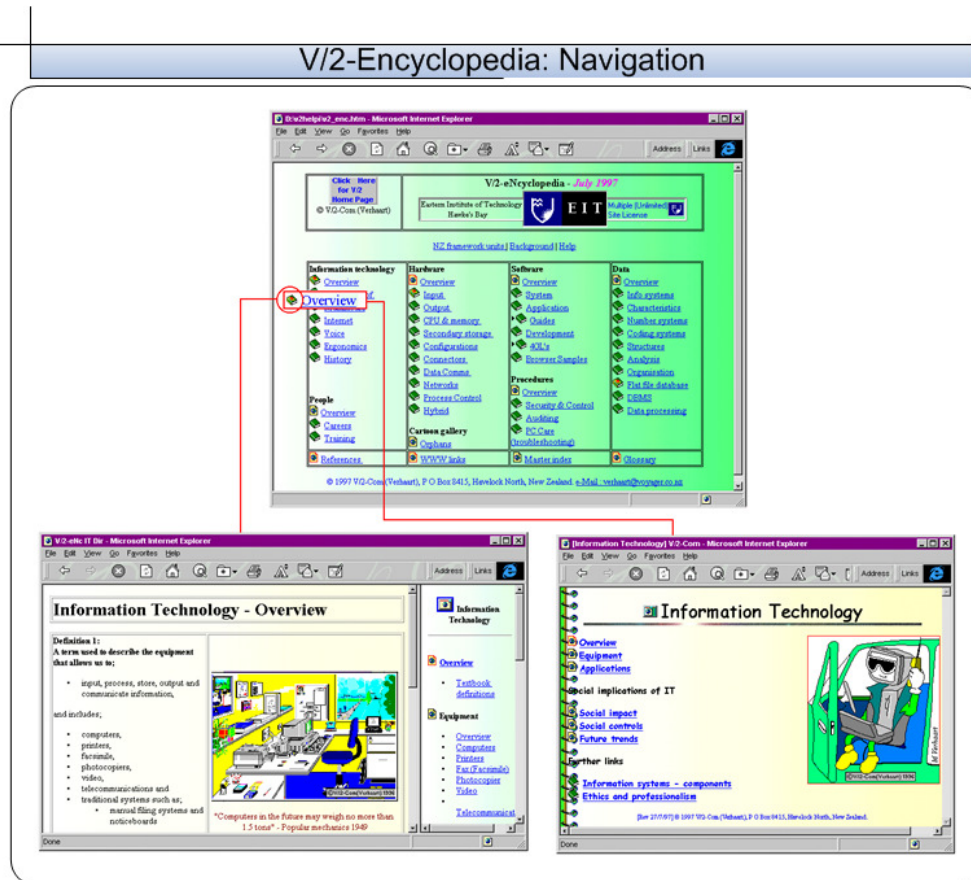


Figure 4-2: Single Frame/Dual Frame Linking

Figure 4-2 illustrates how the WinHelp files were converted to an HTML format. Goals for this prototype included the ability to:

1. have easily maintained and updated on-line electronic notes;
2. make the content appealing to the students;
3. "publish" hard copy notes for students when required;
4. produce overhead transparencies (OHTs) without reverting to another product - for the times when not teaching in a computer room;
5. use a computer projector to display the notes when one is available;
6. use the same notes across several teaching programmes;
7. provide on-line manuals to introduce applications to students; and
8. build the notes to enable other colleagues to use the material.

With regard to the first goal, experience with the WinHelp based notes allowed this to be easily addressed. Compared to the WinHelp files, the HTML version was more easily maintained, but was more difficult to update due to the number of files. To make the notes appealing, many cartoons were introduced, and this resulted in favourable comments from student.

Better than expected results were achieved for the third goal. In Internet Explorer (IE), if a small (or large) screen font is selected this is carried through to the printout. This enabled the production of student notes (small font) and copy suitable for overhead transparencies (large font).

A difficulty in HTML version was the inability to produce page breaks at desired places. This resulted in undesirable consequences, such as orphan heading on the bottom of a page, notes on the next page, or a table split between two pages. Selecting a portion of the page for printing was a way to get around this.

Even though the content was available online, students would copy out the content when displayed in class on an overhead, so from a time management view there was no advantage time wise of using electronic as opposed to acetates. However, the ability to include multimedia, such as animations and sound, enhanced the delivery.

A further goal was to allow the material to be used across many programmes. This was addressed by organising the content by domain rather than programme. Content for a particular programme was then hyperlinked back into the domain based structure. One advantage of maintaining content in a domain structure is that students could explore related content rather than just being presented with content directly related to their programme. It was hoped this would prepare the students for web based research with potentially billions of pages available.

Another goal of the prototype was the ability to create training guides. In the multimedia class, students need to be taught the fundamentals of



## Chapter 4

several packages, and in most cases they just needed a starting example to get underway. So "guides" were developed to introduce concepts such as animated gifs and morphing. Both proved successful with the students as they could print them out when they wanted, rather than waiting for the tutor to cover them

An observation from a colleague was that the concept of an encyclopaedia is actually an environment that encourages sharing and collaboration, rather than a tightly bound set of personalised notes (This premise is supported by the success of Wikipedia). The prototype developed was used at the researcher's institution and was purchased by several secondary schools highlighting the ability of the encyclopaedia format to be used in diverse situations.

### 4.3.2 Adding multimedia - animation, video and sound

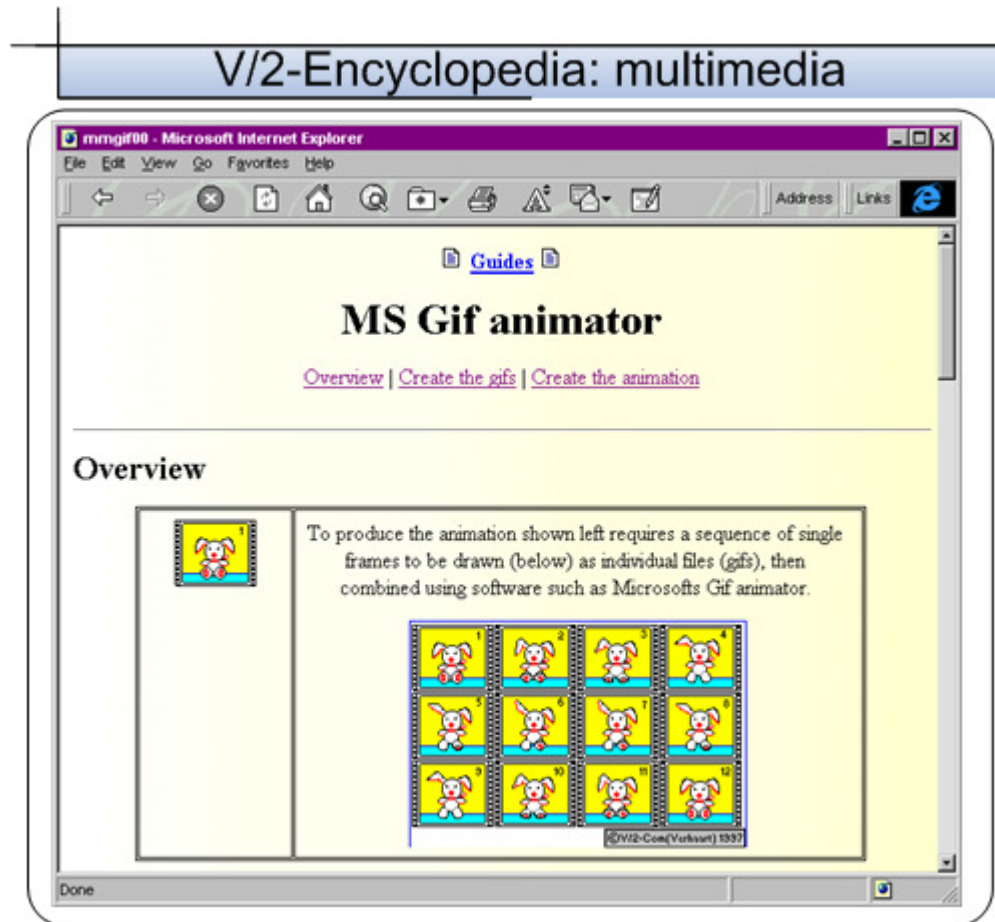


Figure 4-3 : Guide / Multimedia elements

Studies have shown that interactive multimedia improves information retention; people retain 10 percent of what they see, 20 percent of what they hear, 50 percent of what they see and hear, and 80 percent of what they see, hear, and do (Fletcher, 1990). The goal of this prototype was to use the multimedia capability of the HTML to enhance the on-screen presentation of the notes, and stimulate more of our senses.

Figure 4-3 illustrates how a discussion of an animated gif file was represented by a combination of a static image (the grid on the right) and animated image (top left). In this case the static image displays the frames that make up the animated image.

### 4.3.3 Adding interactivity

In an attempt to introduce interactivity, client side Microsoft ActiveX Controls were created, as illustrated in Figure 4-4.

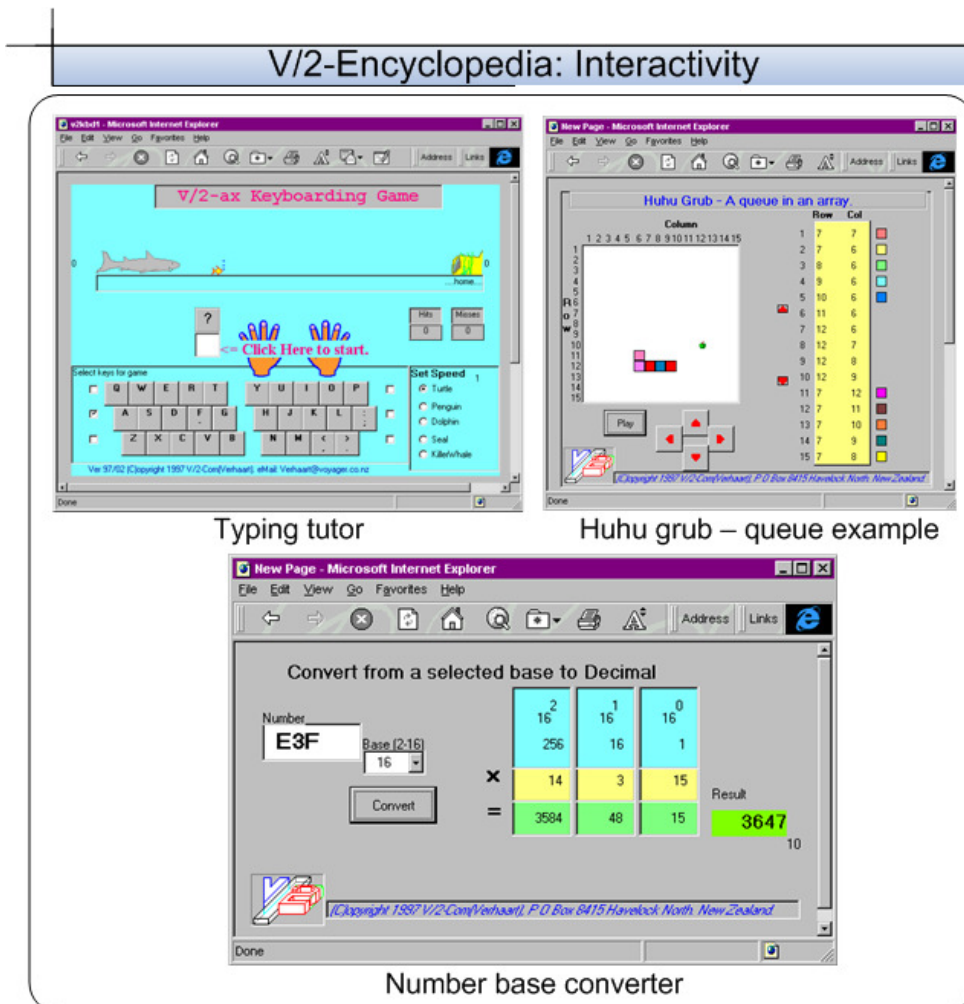


Figure 4-4: Interactive Web based Active X Controls

The goals of the prototypes shown in Figure 4-4 were:

- to produce an interactive typing tutor to teach basic typing skills,
- to develop a program that illustrates how a queue in an array works, and
- to develop a calculator that converted a number in a selected base to base 10 and showed the workings.
- Microsoft's Active X technology for this purpose has now been superseded by JavaScript and Flash.

### 4.3.4 Online theory test

V/2-Encyclopedia: Form prototype

**2786 - Database theory test 1a**  
Create and use a computer flatfile database using base functions

Name/Code: K12345  
Assessor: MHV

Conditions:  
1 Must be done in supervised time  
2 Maximum time 20 minutes  
3 Open book.

Instructions:  
You may either fill out the form on-screen and printout or, Printout the form and write in your responses. (Use the browsers print button).

Elements Assessed: 1. Demonstrate knowledge of the uses and features of databases.

1 Identify one use for a database.  
Maintain a list of plants and their characteristics

For this use list two advantages (be specific).  
a. Updating data  
New varieties are easily added  
b. Selection of data  
Plants with a particular characteristic can be chosen

2 Identify a second use for a database.  
Real Estate listings

For this use list two advantages (be specific).  
a. Updating data  
Changes of prices are easily made, new houses easily added  
b. Selection of data  
Finding a home with a particular characteristic eg. between 100,000 and 150,000.

3. Identify two database programs or programs that contain a database program.

☒ MS-Works ☐ PageMaker ☐ MS-Word  
☐ Lotus 123 ☒ ClarisWorks ☐ CorelDraw!  
☐ Paintbrush ☒ MS-Access ☐ MS-Excel

[Uses & Advantages](#) | [Examples](#)

Done

Figure 4-5 : On-line theory test

The goal of this prototype was to produce a theory test that students could printout "on-demand".

Students were able to use it as a pre-test by either filling out the answers on-line and printing, or printing then hand writing the answers (Figure 4-5). It was suggested that the prototype could be used where a student with limited mobility was able to use a computer but not able to take a written theory test.

As a pre-test the drawback was that a tutor was still required to assess the student result, however it was later discovered that by using JavaScript and multi-choice questions, students could be given immediate feedback.

It was considered that problems would arise if this was to be used as a final assessment, since students were able to copy material from the online encyclopedia, by browsing the html files for answers. It would therefore be questionable if this was a valid form of assessment.

### 4.3.5 Issues

The prototypes identified several related issues, including managing the files, copyright, and systems conforming to institutional standards.

As multimedia objects reside in separate files to the html file these needed to be managed in subfolders, and the sub directories contained from 60 to more than 250 graphics, whilst the home directory contained in excess of 350 HTML files.

Most of the files were small, being around 4-8 kilobytes for an HTML or graphic, and usually less than the typical cluster size on the hard disk (on a 512MB+ drive this can be 16K, on a 1GB drive this can be 32K). This resulted in huge amounts of wasted disk space. Fortunately 32 bit disk access was introduced into the operating systems around that time to fix this problem.

Internet copyright is a complex issue and is not easily managed. In 1997, companies like Hewlett Packard (<http://www.hp.com/ahp/HPCopyright-97.html>) had an open copyright policy, and stated “*permission to use documents delivered from this World Wide Web server and related graphics is hereby granted*”, whereas Microsoft and others took a more traditional view “*No logo, graphic , sound or image from any Microsoft website may be copied or retransmitted unless expressly permitted by Microsoft.*”. Things get complicated with Internet magazines dumping internet pages onto a cover CD. Contact with PC World editor Chris Keall solicited the following response, “*it’s okay to reprint articles for educational, non-profit purposes, as long as the source is prominently credited.*”

Interestingly, peripheral issues had the potential to affect the development of this research. At the researcher’s institution a set of standards for the internal intranet were issued for HTML files. Many of the prototypes fell outside of the standards, so allowing students to take advantage of the research was at risk of being banned by the standards. Furthermore, the

Institution specified that only Netscape Navigator would be supported, which unfortunately does not have native ActiveX support. Recognition of the difference between an academic environment and that required by administration was needed to proceed on this issue. Fortunately for this research, Internet Explorer eventually supplanted Navigator as the Browser of choice.

#### **4.4 V/2-Encyclopedia                      Prototype                      II (2000 - 2002)**

The speed of evolution of both the features and capabilities of the html style (e.g. frames, improved layout design, and so on), and the dynamic nature of the computing industry - requiring constant updating of material, made conversion a slow and time consuming process. Recommendations of Yale University's Lynch and Horton (1999) were used in the design of this second prototype's user interface. They indicated that to provide both a good online interface for pages and easy printing or saving of the content, pages should be divided into chunks of two or three printed pages. This prototype's goal was to attempt to produce a single printed page for each web page. It was suggested that table borders are ugly, so these were progressively removed.

It soon became apparent that the same problems that previously existed with the WinHelp file format reoccurred in html format. The printing of lecture material by students produced huge amounts of paper with a minimal amount of text and graphics on each, and the printing of notes produced 'continuous' pages of poorly formatted documents. The alternative of printing selected portions of a long html document was unattractive since this would produce disjointed information with no context. Furthermore, with particularly long html documents, it was not an easy task. As an example, Oracle 8 (1998) provided user manuals in an html format, yet in one instance, an individual html page exceeded 200 printed pages. Finding relevant content and printing selections within this became a time consuming and tedious task. Informal discussions with others converting

material to html but in a business context, indicated they too were facing similar problems in producing html pages suitable for hard copy (Verhaart, 2000).

So a problem was how to produce a consistent html format that would cope with producing a significant amount of teaching and learning supporting material that included producing:

- a consistent screen interface while producing good printed copy, and providing a source for lecture materials;
- overheads for teaching, comparable to slides produced in a presentation package such as PowerPoint;
- associated handouts relating to the overheads; and
- workbooks suitable for hard copy publication.

Clarity on screens and printed pages, logical navigation required for the various materials, and displaying appropriate amounts of information were also important considerations. The ability to produce a single A4 printed page increased in importance, particularly when a pay per sheet system for students was implemented by the institution. As a consequence of this, it was important that there was sufficient quantity of information on a page to warrant printing.

A significant problem was the effort required to construct each page independently. If an ordered structure (taxonomy) would be developed then positioning each page in this taxonomy could become difficult. In a printed book, page numbers keep a sense of order and position, but replicating this on a web page (commonly by using forward and back buttons) was a time consuming task, and was implemented in the same way a sequential update was achieved when tape drives were used to store database records.

Embedded JavaScript was used to simplify this but could only be tested in a web browser and not while authoring.

Cascading Style Sheets were introduced with HTML 4, which allowed for better control of formatting and some independence from the strict formatting imposed in earlier HTML specifications. Unfortunately, this required all earlier HTML pages to be adjusted to take advantage of the cascading style sheets.

Ad-hoc enquiries were possible using search facilities provided by the web server. The major drawback of these search results was the inability to maintain the context of the found web pages, with a random list of web pages delivered to the end-user.

In order to manage and share the content, this prototype was built on a two-layered model where presentation included an A4 printable page with icons that linked to pages suitable for projection onto an overhead screen in a lecture. Figure 4-6 shows an example from the system with the taxonomy in the left frame, and the printable page in the right frame (shown centre) that links to 4 overhead displays (on the right).

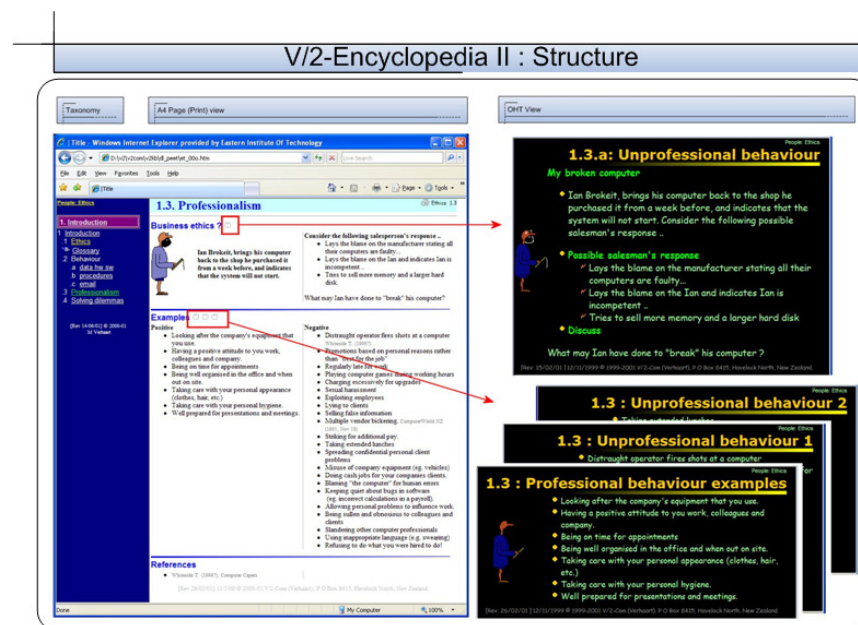


Figure 4-6: Static web site showing printable and overhead forms

As this prototype progressed, the content domains were blocked into lessons, and icons were introduced to give visual clues to the content.



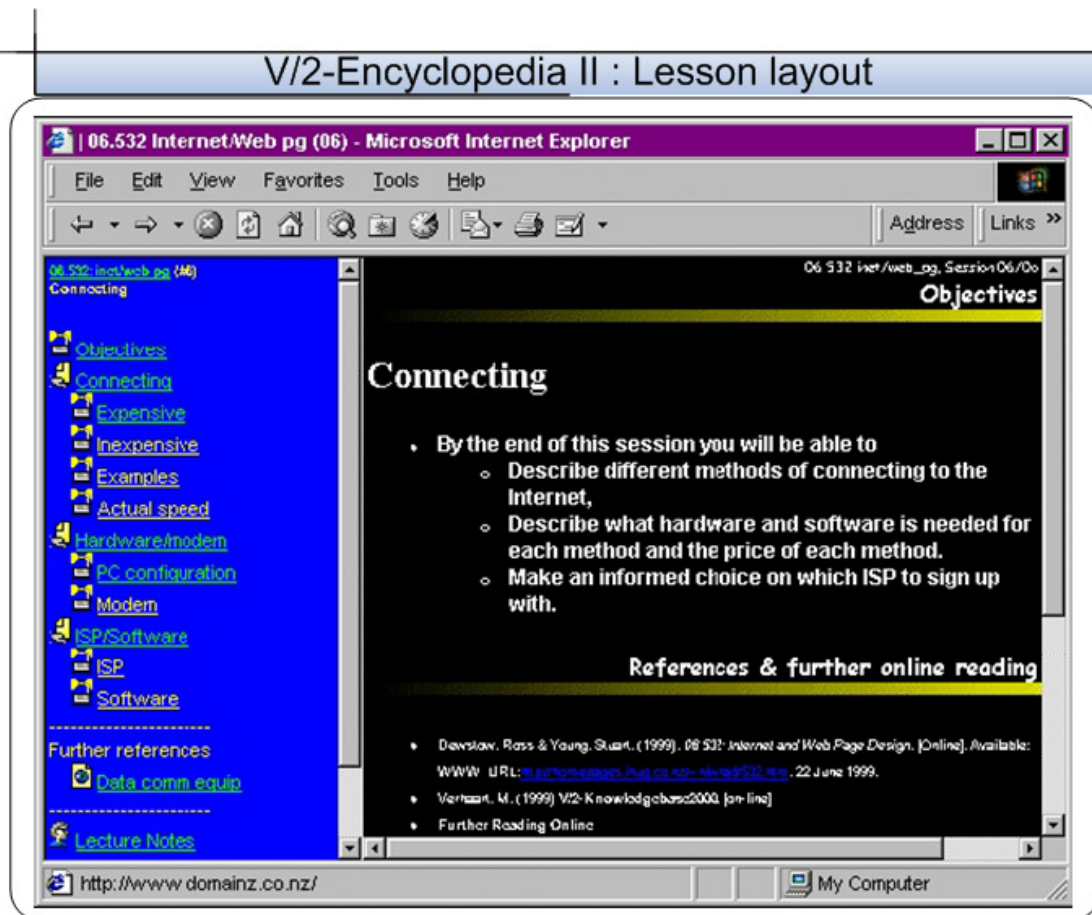


Figure 4-7: Lecture format.

Figure 4-7 illustrates how a lecture was presented in the web site. An index was displayed in a frame on the left hand side of the screen, while the overhead was displayed in the right hand frame. Handout pages were printed prior to the lecture, or could be printed and bound into the course reference book. In the lecture, the appropriate topic was selected, and then by selecting the overhead hyperlinks, the lesson proceeded.

V/2-Encyclopedia II : Lesson contents		
Link to course page	<a href="#">All 500 technologies (40)</a> <a href="#">Connecting</a>	FileNames _06532.htm
Overhead	<a href="#">Objectives</a>	I_06o0o.htm
Handout	<a href="#">Connecting</a>	I_o6h1.htm
Overheads related to handout	<a href="#">Expensive</a>	I_o6o1a.htm
	<a href="#">Inexpensive</a>	I_o6o1b.htm
	<a href="#">Examples</a>	I_o6o1c.htm
	<a href="#">Actual speed</a>	I_o6o1d.htm
Knowledgebase link	Further references <a href="#">Data comm equip</a>	
Lecture notes	<a href="#">Lecture Notes</a>	I_o6a.htm

Figure 4-8: Detail of the lecture contents frame

Features of the lesson content frame are illustrated in Figure 4-8, and include the following items:

- A link to course page which takes the user back to the course page (\_06532.htm). A file naming convention was developed that enabled efficient management of the numerous files that are created.
- An overhead icon that linked to a slide suitable for projection or printing to a transparency.
- A handout icon to indicate a printed page formatted html document. In classes, these were published and handed out to students. Associating overheads to handouts was a technique that minimised excessive paper usage, and enabled changes to be made efficiently.
- A knowledgebase link indicated supplementary material.
- A lecture notes' hyperlink to a page describing the session teaching notes. This includes things like delivery methods and extra examples.

#### 4.4.1 Printable documents: Textbooks and workbooks

As part of this iteration, the ability to provide printable textbooks and workbooks was explored, where they could be produced directly from the

web site. A workbook is used by students to learn a new software application. Samples of these are shown in Figure 4-9.

## V/2-Encyclopedia II : Textbook and workbook samples

### What is a flatfile database?

**Definition**

• **Flatfile database (or File management system)** is a simple data management system that can perform many of the activities needed to manage single-file systems, such as, create, edit, search, update, report.

It combines the features of a **database** (where the data and the definitions about that data are stored) and the **database management system** (the tool used to store, organise and retrieve the data).

**Create a manual database**

Say we want to collect some personal data about a set of students.

Firstname, lastname, preferred name, computer level (0-none, 10-guru), interests and favorite music.

We can collect the data in one of two ways.

The first is to get a piece of paper and create columns called firstname, lastname etc.

First	Last	Preferred	Level	Interests	Music
Terry	Dwilt	Terry	5	horses	oldtime
Dona	See	Don	6	guitar	reggae

Problems occur when:  
You get someone with lots of interests.  
Deleting students from your list also makes your page very messy, and you need to re-write the list to sort it.  
You can't fit all of the columns across the page.

**Exercise: Student data.**

To get you started print out (or draw you own) 5-10 student record forms to enter student data. If you are working on your own, fill out the forms by making up the data. In a class complete the form for yourself and create a class database.

**Questions**

- Sorting:  
How would you sort the data? By name. By computer level.
- Searching:  
How would find out if a particular person is in the class?
- Reporting:  
What is required to produce a class list for everyone in the class.
- Privacy:  
Some people object to certain data being collected. For example birthdate, gender (male/female), ethnic origin. Why is this? Do you have any data that you would not like collected?

When designing a database questions such as these need to be considered.

**Basic definitions**

In a (flat-file) database

- **Field** is a data item. For example a persons name.
- **Record** is related data about one thing (called an entity). For example, data about Terry Dwilt.
- **Table** stores the raw data. Most often viewed as a list (in columns).

• **Form** displays one record. (one row in the table)

• **Report** summarises and presents the data from the tables either on-screen (print preview) or on-paper.

Forms and reports are two of the tools that process the data into information.

### 3.2 - Database & table: Create

**Create database and employee table**

- Create a new database called payroll.mdb
- Create a new table called tblEmployee in design view

Field Name	Data Type	Description
EmpId	AutoNumber	Employee Id
LastName	Text	
FirstName	Text	
Address1	Text	Address line 1
TownCity	Text	Address line 2
Phone	Text	
StartDate	Date/Time	
HourlyRate	Currency	

Figure 3.2.1: Create employee table

**Sample data**

- Enter some sample data into the table, include one record with your name - to enable you to identify any reports.
- (to get you started! - EmpId is omitted):
  - Computerman, Mista, 12 Kea St, NAPIER, 06-876 1122, 12/1/94, 20
  - Buniny, Floptical, 14 Tul St, NAPIER, 06-876 5432, 15/6/95, 10
  - Potamus, Waterlily, 17 Red St, HASTINGS, 06-877 1234, 10/2/95, 9.5

**Create timesheet table**

- Create a new table called tblSheet in design view

Field Name	Data Type	Description
EmpId	Number	Employee Id
WeekNum	Text	Week Number
Hours	Number	Hours worked

Figure 3.2.2: Create timesheet table

**Notes:**

- The AutoNumber data type is used in a field in which the computer is to generate a new number for you each time a record is created.
- To force uppercase onto TownCity enter ">??????????" - with the number of question marks (?) equal to the field length, into the input mask. (A ">" in the format field will display the address in uppercase, but store as typed in the database.) This will ensure that if the data is exported to another application, such as Word in a mail-merge, the data will remain uppercase.
- Use [Tab] to step over the AutoNumber field. Access will generate the next available number once the record is committed to the database (i.e. when you tab to the next record).
- It is important to enter reasonable data so that forms and reports can be tested for accuracy.
- Double click on the bars between the field names to resize field widths. TownCity + Phone displayed. (Does not change the actual field size).
- The EmpId field size is a Long Integer, since an AutoNumber is stored as a Long Integer and this field is to relate to the EmpId in the Employee Table.
- To create a composite primary key, highlight both EmpId and WeekNum by dragging your mouse over the grey cells on the left of the field names, then click on the key button.
- When editing a record use [Shift] + [Enter] to save the changes without leaving the current record.

**Sample data**

- Enter some sample data
  - Sample data:
  - 1, 5, Apples, 34
  - 2, 5, Apples, 30
  - 1, 6, Apples, 30
  - 1, 7, Pears, 20
  - 2, 7, Pears, 20

Figure 4-9: Text book sample (left) and workbook sample (right)

## 4.5 Findings, observations and reflection

### 4.5.1 Information and knowledge acquisition

#### 4.5.1.1 Content and context

The capability of the html format to acquire, manage and disseminate context while retaining context was demonstrated in the prototypes described. Using html, a hyperlinked structure managed the context and the

way that media elements were managed as separate entities kept the physical size of the content to a minimum.

Accuracy and reliability of the pages was a significant issue and a considerable time investment was required to maintain the static pages. Conversion of electronic material was a labour intensive and time-consuming task, with each page having to be constructed individually into the HTML structure. With the number of pages increasing to approximately 4,000 html files and over 8,500 electronic media and multimedia files (Verhaart, 2000), the ability to keep them accurate became increasingly difficult. It was noted that if 1 minute was to be spent checking each page it would take more than 65 hours to make a complete check! The introduction of tools such as Microsoft's FrontPage made this task less demanding, but still each page was a separate entity. Often students would either verbally inform, or e-mail the lecturer to indicate that a page had some inaccuracies. Matching up comments with the problem was difficult, and more often than not pages were left as they were. In one case, during an assessment a student indicated that a modern, multimedia PC was a 486 with 16MB RAM (which indeed was the case two decades ago). When questioned, they indicated that this out-of-date information was in the online material!

#### **4.5.1.2 Teaching and learning**

The prototypes developed demonstrated the feasibility of creating content in a form suitable in a teaching and learning environment. The ability to consolidate content into a sequence and to be able to display the content in a form suitable for projection were found to be very useful features.

The advantages of placing workbooks online were highlighted, when teaching a class on multimedia. Students were told that Microsoft PowerPoint would be a suitable software package to design a storyboard. Unfortunately, PowerPoint was not one of the products the students had learnt, so directing them to the on-line workbook enabled them to self-learn

the skills necessary. With the workbook on-line, its availability was immediate and required no further input from the lecturer.

The workbooks by necessity are arranged in a linear format (Lynch & Horton, 1999), that is, concepts are explained and then built on as the workbook progresses. This approach is also advocated by Makkonen (1998) to ensure that the student does not get 'lost in-hyperspace'.

Further advantages of placing workbooks on-line included the ability to maintain workbooks tailored to different versions of a particular product. It was not uncommon for a student to have an earlier version (or in some cases, a more recent version) on their home computer. Since the notes were stored in a web site and could be stored efficiently, various versions of the same product become accessible. Further, in one of the classes the researcher assumed students had already learnt a product but found this was not the case. Students were able to generate their own workbooks, printing only pages they needed for the level they wished to use.

### **4.5.2 Mechanisms for acquisition, management and dissemination of information and knowledge**

#### **4.5.2.1 Content acquisition**

The prototypes described how textual content could be captured in html documents and associate multimedia linked, allowing for a media rich teaching and learning environment.

At this stage it was found that the images displayed on-screen could be improved when printed on paper if substituted with a higher quality image. Unfortunately, providing higher quality images impacted significantly on download speeds particularly as dial-up access was the normal access method. The ability to deal with providing alternative images for display and printing was developed in the next prototype.

#### **4.5.2.2 Annotations**

In the static prototype annotations were not possible, but it was apparent that they would be a very useful extension to the evolving framework.

#### **4.5.2.3 Learning/Content management systems**

The prototypes highlighted several issues that would need to be considered to develop an effective teaching learning/content management system.

Providing logical and consistent page numbering in the learning material was addressed. Occasionally a concept needed to spread to more than one page (see Figure 4-9). This was handled by adding a visual clue using VCR buttons at the top right of pages.

Html is also efficient in terms of file size. Including graphics in word processors often causes file sizes to balloon rapidly, whereas in html the gif / jpg file formats compress very efficiently.

Although there were advantages in providing the material in an electronic format, it was not always possible to schedule a room with a computer data projector, where such electronic material could be used during the lecture. When this occurred the overheads needed to be printed onto acetate for use by an overhead projector. Referring to Figure 4-7, the overhead on the right has a black background. When printed on a black and white laser using the browser, the text colour was a light grey. Unfortunately this is useless for projection, but fortunately Internet Explorer provided a solution under accessibility options, where background colours could be overridden.

#### **4.5.3 Identified features and issues**

Verhaart (2000) identified issues that were resolved with this prototype and these included:

- design issues ( margins, printable areas);

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- formatting issues (paragraphs and tables, horizontal and vertical lines); and
- display issues (hiding graphics when printed).

Table 4-1 lists the features identified as important during this action research cycle.

Table 4-1: Important features identified from cycle one of action research

1. Have easily maintained and updated online electronic notes.
2. Make the content appealing to the students.
3. Provide the ability to "publish" hard copy notes for students when required.
4. Produce overhead transparencies (OHTs) without reverting to another product - for the times when not teaching in a computer room.
5. Allow content to use a computer projector to display the notes when one is available.
6. Enable the same notes to be used across several teaching programmes.
7. Provide online manuals to introduce applications to students.
8. Build the content to enable other colleagues to use the material.
9. Leverage the multimedia capability of HTML to improve student information retention.
10. Use client side scripting to develop interactive content for constructivist learning.
11. Designing content so that it can be printed onto a single A4 page.
12. Providing logical and consistent page numbering in the learning material.
13. Providing a consistent screen interface while producing good printed copy, and providing a source for lecture materials.
14. Enabling overheads to be produced for teaching, that are comparable to slides produced in a presentation package such as PowerPoint.
15. Providing a clear link between handouts and overheads.
16. Designing content in a workbook format suitable for hard copy publication.

Table 4-2 lists the issues identified as important during this action research cycle.

Table 4-2: Issues identified from cycle one of action research

1.	Managing the significant number of small files.
2.	Dealing with copyright.
3.	Dealing with institutional policies.
4.	Dealing with the rapid evolution of Internet technologies.
5.	Problem of large amounts of white space and small amounts of text when content produced for overhead display was printed.
6.	The effort required to construct each page independently leading to problems of accuracy and reliability of the pages.
7.	Providing an effective search mechanism as the results of the search lost context, with a random list of web pages delivered to the end-user.
8.	Maintaining the accuracy and reliability of the pages.
9.	The difficulty in matching up user comments with an identified problem. More often than not pages were left as they were.
10.	Design issues (e.g. margins, and printable areas).
11.	Formatting issues (e.g. paragraphs and tables, horizontal and vertical lines).
12.	Display issues (e.g. hiding graphics when printed).
13.	The ability to deal with providing alternative images for display and printing.



## 4.6 Conclusion

This chapter presented the initial background to the research. In an attempt to capitalize on the emerging electronic media in a teaching and learning environment several prototypes were developed. Prototypes to demonstrate the feasibility of using electronic media where content was stored electronically, to the use of static internet technologies were developed and discussed.

The development of the static prototypes provided important signposts that would assist in developing the dynamic prototypes that followed. They proved the technology and the capability of the technology to deliver in a teaching and learning environment.

Dynamic (database driven) web technologies were emerging, and the internet progressively become faster and more affordable.

Drawbacks of the static prototypes were the requirement to hand-code all the pages, a low level of student interaction and the inability for students to contribute to the class content. The following chapter discusses the development of a dynamic prototype, that, as well as providing the features of the prototypes discussed in this chapter, also enabled student information and knowledge to be acquired in context and added to the content of the course.

## **5 Action research cycle two: V/2-Online dynamic prototype**

The previous chapter discussed early static prototypes that managed teaching and learning content, essentially managing content presentation. The shortfalls of the static prototypes and their unwieldy nature suggested a different approach, so research into alternative methods was undertaken.

Internet based database technologies were rapidly evolving and provided an opportunity to extend the features found useful in the static prototypes, such as the ability to allow users to dynamically update and add to content. For the content each overhead was represented by one record in a database table, and by linking the records together the content could be displayed in a continuous format, which was also suitable for printing. Allowing users to attach comments to a content record enabled student information and knowledge to be captured, thus, source data capture became possible.

Many new possibilities emerged as the database prototype evolved, and included: improved pedagogical considerations, the ability to provide scaffolding, footprints, and exploration space controls.

### **5.1 Methodology**

#### **Sample**

Teaching and learning content created in the static prototypes was converted into the database format. Internet and Web Development, Multimedia and Database papers were converted and delivered to diploma and degree level students. In addition a literature review sub-system and business card manager were developed that tested the extensibility of the proposed structures. The Internet capabilities were extensively tested and trialled particularly in the case of the content for multimedia papers.

### **Procedures**

Dynamic prototypes were developed to trial and test structures that would leverage the capabilities of the interactive Web technologies that were rapidly evolving. These included the ability to capture and organise the content, allow users to add annotations to the content, and manage media elements in a common and controlled way.

### **Instruments**

As in the first action research cycle, prototypes were developed and modified based on feedback through discussion with student and colleagues. In addition a discussion paper was prepared for the International Forum of Educational Technology Society (IFETS) and the Distance Educators Association of New Zealand (DEANZ). At the conclusion of the discussion an online questionnaire was made available, and the results were summarized and published (Verhaart, 2003b).

## **5.2 V/2-Online Prototype (2002 - 2005)**

Several factors influenced the development of an extensible content management system using database and internet technologies. There was a desire to improve the quality of content delivered to students and the need to capture and include the knowledge of students as both moderators and contributors. From an applied research perspective, there was an opportunity to develop a real application that allowed the development of a generalized meta-data schema for divergent data types to be captured at the source.

An area that static prototypes were not able to address was the collaborative advantages that are part of the face-to-face contact in classrooms. Students can contribute information and knowledge to a topic that may be based on their “real-world” experience, provide insights that can generate class discussion or comment, or give an observation such as an error or omission

in the content. Hence the ability to add “annotations” directly to content was desirable.

Collaboration using the internet was increasingly being recognized as an important pedagogical concept and research was being done in areas such as bulletin boards and email systems. In 2002 the proceedings of the IEEE International Conference on Computers in Education (Kinshuk, et al., 2002) included 41 papers under the heading “Collaborative Learning/Groupware/Co-operative Learning”.

### **5.2.1 The database solution**

From about the year 2000, there was a move to database driven web sites, and this presented the opportunity to re-develop the content delivery prototype. Many of the drawbacks found in the static prototype could be addressed and user interactivity was also explored.

From the original file sharing prototype, a major requirement was the ability to provide content in multiple formats: suitable for displaying notes, presenting on an overhead, and for printing.

In order to proceed, a preliminary schema based on the features that evolved from the static prototypes was designed that would satisfy the following basic requirements, that is, the content must be:

- able to contain detailed notes;
- displayable on an Overhead Projector (OHP); and
- able to be displayed in a form suitable for hard copy.

An important part of database design, is defining the smallest workable unit or entity, and after several prototypes, the content fragment that proved to be most workable was **"a piece of knowledge or information that could be represented by one overhead transparency"**.

In order to provide a way to refer to this, the term “**Snippet**” was coined (Verhaart, 2002, p. 1485; Verhaart & Kinshuk, 2003, p. 153). In a sense, a snippet is a specification for a type of learning object, and this relationship will be covered later in this thesis.

To develop a usable prototype, core attributes of the snippet were identified, and these are listed in Table 5-1.

Table 5-1: Core snippet attributes

- |  |
|--|
| <ul style="list-style-type: none"><li>• <i>Creator</i>. The person who created this snippet. The term creator is consistent with the Dublin Core metadata element set (2008b).</li><li>• <i>Snippet identifier</i>. A persistent identifier to uniquely identify this snippet.</li><li>• <i>Taxonomy identifier</i>. Enables a link to a specific structure. Whilst a snippet could be referred to in many domains, for this prototype a snippet was attached to a single taxonomy. Guarino and Welty (2002) refer to this as a "backbone taxonomy".</li><li>• <i>Title</i>.</li><li>• <i>Description</i>. The textual content.</li><li>• <i>Summary</i>. Textual content used for the presentation mode.</li><li>• <i>Multimedia identifier</i>. A link to a multimedia element to be attached to this snippet. It should be noted here that in this prototype a decision that only one media element could be attached to each snippet was made. In later prototypes this was changed to allow many media elements to be attached to a snippet.</li><li>• <i>Bibliographic identifier</i>. This links to a table containing all references. As for media elements this prototype allowed only one bibliographic link for each snippet. This also was changed in later prototypes as many snippets were constructed from multiple references.</li></ul> |
|--|

Based on the core attributes identified in Table 5-1, a snippet architecture was designed and a simple schema was developed in Microsoft Access (Figure 5-1).

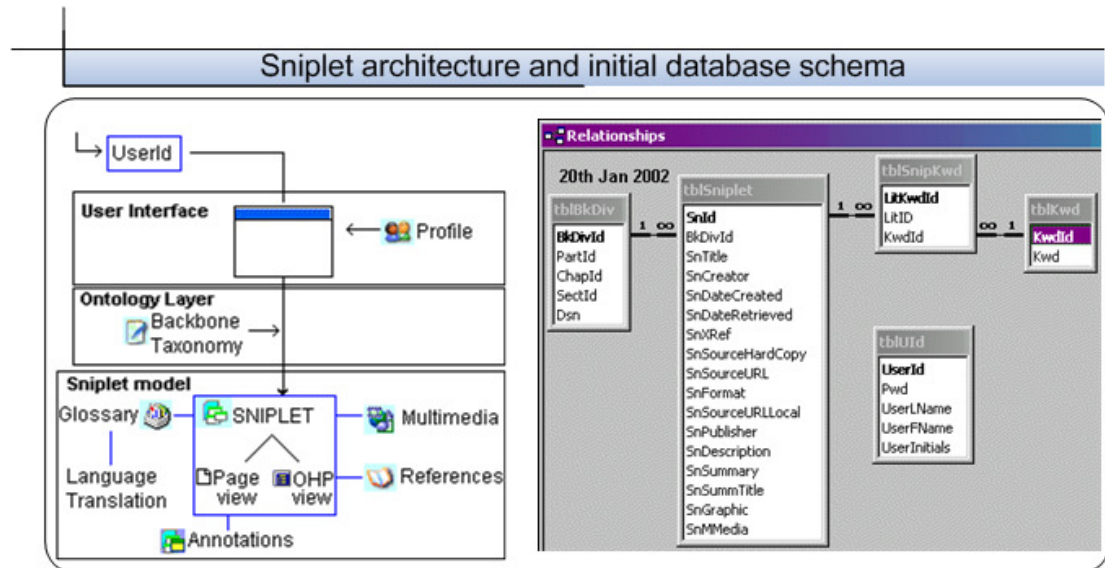


Figure 5-1: V/2-Online Architecture and initial database schema.

The snippet entity (tblSniplet) contained the attributes describing the snippet (such as title, creator, and description). The taxonomy was managed by the entity book division (tblBkDiv) as at the time the researcher was following a book metaphor. Users profiles were managed in a user table (tblUIId), and keywords were handled in two tables, a structured list of keywords (tblKwd) and the keywords attached to a snippet (tblSnipKwd).

The next step was to determine the technology that would be used to create the prototype so it could run on the internet. Microsoft's Active Server Pages (ASP) technology was selected for several reasons. ASP is based on Microsoft's Visual Basic and this was within the skill set of the researcher. Microsoft Access integrated well with ASP and required minimal database administration to set up and manage. Further, Microsoft Access provided all the development tools in one package such as table creation, relationship diagrams, form generation and report design, and did not require a web server for initial development. Brinkster (<http://www.brinkster.com>) provided a free web hosting solution that supported ASP and Microsoft

Access. A discussion on developing the ASP skills and comments regarding comparable technologies such as PHP, was described in Verhaart and Jamieson (2002).

### **5.3 Findings, observations and reflection**

For this stage of the action research cycle, observations and reflections are made that address the research problem as stated earlier, that is, *“can a framework be developed to acquire contextualized information and knowledge that may exist in a variety of data types, at source?”*

Research into the V/2-Online framework was conducted in the following ways:

- Through the cyclic design and development of a prototype;
- Through discussion with users of the prototype;
- By analysing data collected while users were working with the prototype; and
- Via a survey of educators skilled in the use of online academic systems.

Research findings related to the V/2-Online framework have been published as follows:

- An analysis of survey results (Verhaart, 2003b);
- A reflective discussion relating to the pedagogical value of the research (Verhaart & Kinshuk, 2004b);
- An evaluation of the annotation framework (Verhaart & Kinshuk, 2005b); and
- The design of the multimedia object (MMO) (Verhaart, Jamieson & Kinshuk, 2004).

### **5.3.1 Information and knowledge acquisition**

#### **5.3.1.1 Content and context**

The problem statement for resource acquisition, management and sharing at source for this thesis was *“can a model be developed that has the ability to retain context while transferring the content from one person to another and from one place to another?”*

As mentioned in the introduction, as the snippet library grew there evolved a need for a better way to organise and retrieve attached objects. As discussed in Chapter 4 (4.5.2.1) image quality could be improved if different versions were available for “on-screen” display and for printing. In this prototype two images were created, and the appropriate image was used relative to the output context. Image captioning could be automated through the use of attached metadata.

This concept evolved into a need to describe media objects in a consistent way that allowed for the multiple output requirements. Hence a model that allowed multiple representations of the same media object was developed.

How we gather and collect knowledge and information, and the way it varies depending on context was investigated. Verhaart, Jamieson and Kinshuk (2004) looked at the state of media objects, both physical (such as a book or a person) and electronic (such as a multimedia file: image, sound and video), and standards available to manage the metadata.

An XML based vocabulary was proposed, that allowed multiple representations of a wide variety of media elements. It is discussed in detail in Chapter 8.

During this phase of the research the concept of a consolidated multimedia object evolved. The initial design had a single media image attached to a snippet. This was extended to the realisation that there were benefits to



having an image stored in two forms (suitable for screen display and suitable for printing). The ability to have a side note that included an additional media element was also seen as desirable, though this was really a way around the restriction of a single media element attached to the snippet. Investigating the inclusion of sound to a snippet showed that there were advantages in being able to include audio as either in-page or on-load (as a background sound).

It was towards the end of the V/2-Online prototype development that the multimedia object (MMO) was designed, that allowed for a media element of any type to be managed via a metadata file, and in a format that allowed multiple representations to be consolidated. This is a core finding of this thesis and will be discussed in following chapters.

### **5.3.1.2 Teaching and learning**

The problem statement for the teaching and learning component for this thesis was “*does the proposed framework provide additional benefits that are not available in current teaching and learning environments?*”

From a pedagogical perspective, the prototype allowed multiple delivery modes. Content could be presented as a lecture, a workbook, or in a handout; delivered in online and offline (hard copy) format; static or interactive; and presented in an objectivist (lecture mode) or constructivist (collaborative) way.

The ability to add annotations extended the course material from an information delivery mechanism to one where students could add their knowledge and interact. For example, a snippet described a graphic card to which the following annotation was attached “*voodoo graphics cards no longer exist*”. Further, social interaction was possible via the annotation feature, and an early comment from a student was “*hey this really works*”!

While students were using the prototype, usage statistics were gathered (refer to Figure 4-7). From a tutoring point of view quantitative data can be used to determine which areas of content were referred to most or least often, and depending on the feedback changes can be made.

Statistics can also provide a useful profile of the learners. During the research on this prototype, discussion on the IFETS list server (<http://ifets.ieee.org/>) often returned to the topic of “lurking”, with participants trying to quantify the usage and relevance. Tracking usage by learner could potentially identify the lurkers.

How does the framework facilitate good teaching practice? The following list discusses observations from actual prototype usage in the context of the “seven principles of good practice” (Chickering and Ehrmann, 1996):

*1. Good practice encourages contacts between students and faculty.*

The prototype implemented an annotation facility that enabled communication between users. Of the 90 annotation records collected, 37 (41%) could be identified as between faculty and students. When the annotations were optional as in the case of Multimedia 58% (14/24) were faculty/student annotations whereas when students were required to add an annotation this reduced to 35% (23/66). An example of an annotation added by a student is “*Michael, you could add something here about the court case against Microsoft – for their (monopoly?) market share.*” With an increasing number of students using laptops in class, there is a need to consider the integration of this technology with the content being delivered. Couple this with wireless technology and a unique blend on traditional and online communication becomes possible. For a short while, students participating in this research had access to the main campus network via a wireless connection. During a lecture, one student suggested an update to the content and an annotation was suggested. The student had already added the annotation. This raises the possibility of the “shy” student interacting in a face-to-face environment by using this technology.

### *2. Good practice develops reciprocity and cooperation among students.*

Through annotations students were able to contribute to the content. In Multimedia (where adding was optional) 3/24 annotations related to students helping other students (e.g. “*here is a good link to a superb program to make QTVR movies without buying apple QTVR authorware – <http://www.panoramafactory.com/download.html>”*). As annotations that added content to the prototype was part of the Internet and Web Design assessment analysis of the results would be skewed.

### *3. Good practice uses active learning techniques.*

The prototype provided many modes of presentation and many ways to navigate through the content. With extensive hyper-linking there are opportunities for discovery learning, and the overall structure is required to manage the cognitive loading on the students. For example, a media or bibliographic element can have links to other snippets using the same media element.

### *4. Good practice gives prompt feedback.*

As the prototype allowed students to annotate content in a contextual way, feedback could be quick and relevant. Face-to-face delivery can give immediate feedback, but this is difficult when the class size is too large or the students do not feel comfortable requesting feedback. To quote an old proverb, “*Better to say nothing and be thought a fool than open your mouth and remove all possible doubt*”! In this case the addition of the on-line option supports a second feedback channel.

### *5. Good practice emphasizes time on task.*

This is not part of the prototype and would be managed by the due dates and regulations within each of the programs.

### *6. Good practice communicates high expectations.*

Using modern technologies to deliver and maintain content encourages students to develop skills in these technologies. Indeed, students requested

additional courses that covered web database technology they were using once they understood the relevance to their domain.

#### *7. Good practice respects diverse talents and ways of learning.*

As mentioned earlier, the prototype allowed for many modes of delivery, and blended learning caters for a diverse range of learning styles. Students learn in a variety of ways: verbally, visually, textually and so forth, so the ability to include a variety of multimedia elements is a real advantage. The development and use of the multimedia object (MMO) is one step that recognises the diverse ways students' learn. Accessibility issues too have been considered, for example, a blind person may set up their system so that all graphics are replaced with audio equivalents.

The prototype was used in two courses in the second semester of 2003. In the first course, an Internet and web design class, a nominal value was placed on an assessment where the students were required to add an annotation. This was done, firstly to encourage the use of the material and second to get the students used to working with the on-line theory notes. For the second course, on database management systems, practical and theory notes were developed that complemented a set text.

#### **5.3.1.2.1 Qualitative feedback – EFETS Discussion forum**

As part of the action research a discussion paper was prepared and posted to a combined online forum of the International Forum of Educational Technology Society (IFETS) and the Distance Educators Association of New Zealand (DEANZ). The discussion ran for two weeks, and approximately 35 identifiable individuals submitted one or more written comments. At the conclusion of the discussion an online questionnaire was made available, and about 30 responses were received. The results were summarized and published in Verhaart (2003b).

The 30 respondents represented at least 12 countries with Australia (3), New Zealand (7), the United Kingdom (4) and USA (6). There was a good gender balance with 15 indicating female, 13 male, and 2 no response. 15 (50%) of the respondents were aged between 41 and 50 with 7 (23%) aged between 51 and 60, indicating significant experience in this field (as was also evident from the postings where many appended their job position).

With regards to the research presented in this thesis, 14 (56%) of the survey respondents indicated that they had viewed the prototype.

The discussion could be classified into five threads:

1. What are the differences between “learning technology” and “educational/instructional technology”;
2. A discussion on using a Wiki as a knowledge capture system to contextualize comments;
3. What is knowledge and how is it defined;
4. A discussion on the relationship of constructivist learning to eLearning courses; and
5. A discussion on the differences between active participation and lurking in an on-line forum.

Comments relevant to the information and knowledge framework included:

- What is mean by the term “knowledge” was discussed. This provided an important direction for this research, as the idea that knowledge belongs to an entity, and in the case of a person is “what you have between the ears” (Goppold, 1996). This initiated a research direction into what was to eventually be coined the “virtualMe”.
- Whether the granularity of the snippets meant that they had become de-contextualised (too specific). The link to the backbone taxonomy was described as a way that the snippets were contextualized.
- As contributions to the prototype were by other individuals how would copyright and modifications be controlled?

- Constructivist learning was also considered in the context of eLearning, and this led to a discussion on on-line participation. One comment stressed the importance of collaboration and teaching students to be team players.
- How the use of online participation improves through assessment was also discussed.

Comments and discussion related to the prototype included:

- Whether the use of a wiki had been considered. This was added to subsequent prototypes.
- There was a short discussion on how bibliographic references could be managed, and whether a global reference index would be useful that could generate a variety of standard referencing styles (such as APA). Some participants indicated this was already being met by Web of Science and NEC's research division site (<http://citeseer.nj.nec.com/>).
- The addition of metadata to electronic media elements and the ability to use this metadata to auto-generate values such as the Alt tag in HTML.
- Discussion that courses are most often structured and linear, was considered good for a number of reasons. The comment was made that *"this concurred with the initial discussion document where keeping content, discussion and learning in context are important considerations for effective learning"*.

### **5.3.2 Mechanisms for acquisition, management and dissemination of information and knowledge**

#### **5.3.2.1 Content acquisition**

Once a workable schema was developed, a way for students (and other users) to attach comments was needed. It was considered important that information and knowledge capture should happen within the domain that

the students were focusing on (highly contextual), and should represent that context correctly to others.

Aside from the actual content itself, information and knowledge could be captured via annotations. At the time annotation techniques were increasingly appearing on the internet. Online news bulletins, such as <http://www.techcentralstation.com>, allowed discussion threads, user feedback and user ratings to be directly attached to the article, and this technique was adopted in the snippet database prototype. To maintain the integrity of the actual content, only users with suitable access rights were able to add this level of content.

To demonstrate the viability of the structure a Microsoft Access database was built for an Internet course that was being delivered. The viability of the structure was established, but many extensions and modifications emerged. The significant additions were:

- the addition of the annotation entity, which was attached to the snippet entity;
- a bibliographic entity that could be referenced by any snippet;
- a multimedia entity, so that multimedia elements could have associated metadata, such as a description, and be referred to by multiple snippets; and
- an independent glossary entity that could be cross referenced when either snippet descriptions or summaries were created.

While these changes were evolving in Windows/Microsoft Access, a parallel Brinkster/ASP/Microsoft Access solution was also being developed (Figure 5-2). This involved splitting the database into a front-end/back-end, and rewriting all of the form handling (front-end) in ASP and working around the idiosyncrasies of both the language and the hosting solutions.

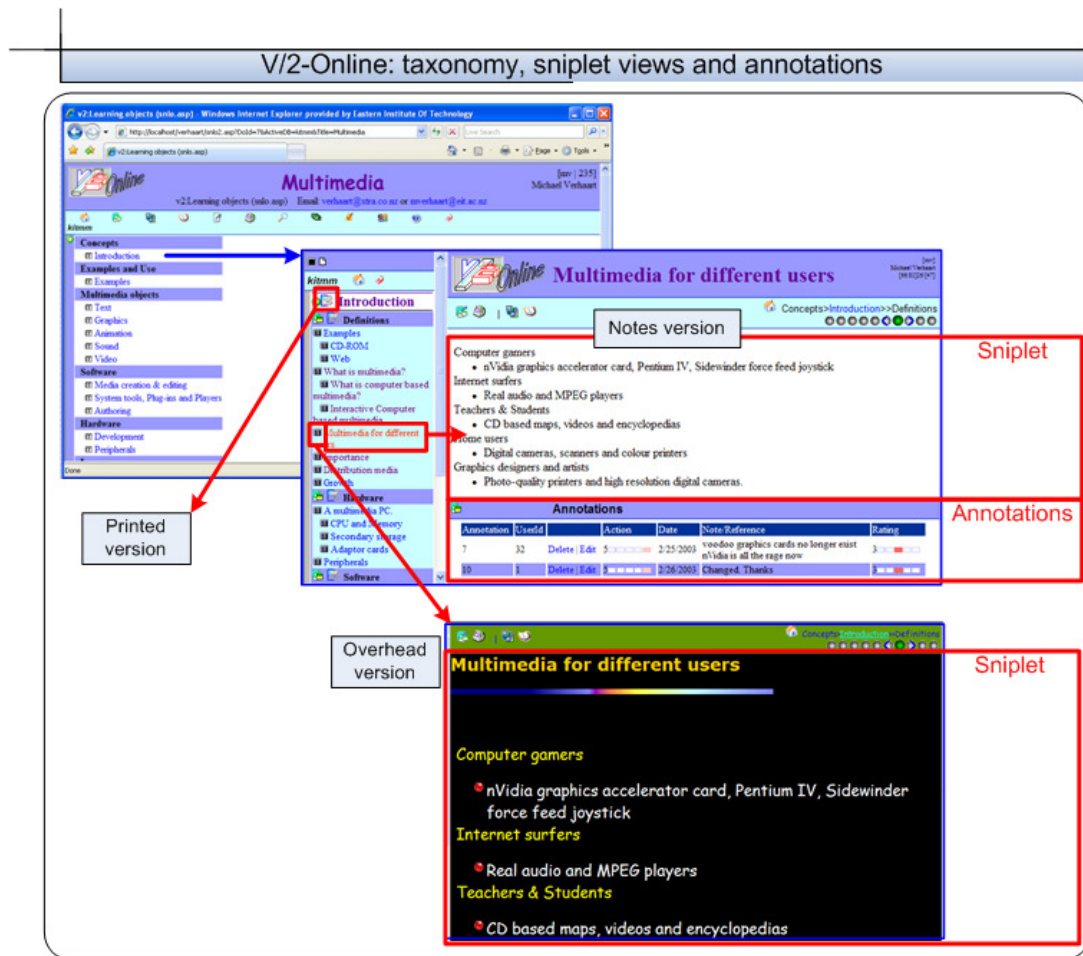


Figure 5-2: Online Snippet prototype showing backbone taxonomy, notes page (with annotations) and overhead version.

The first prototype (<http://www25.brinkster.com/verhaart/default.asp>) was essentially a teaching delivery system designed for a blended (face-to-face and on-line) teaching environment. Content was organized as snippets, and arranged in domain taxonomies, such as multimedia, database, internet and web

Once an online workable prototype was developed, it was trialled on a first year degree Internet class. To encourage participation a small assessment item was attached, where the students were asked to add an annotation to one of the snippets. Although there were technical difficulties and time constraints, constructive feedback on the user interface and structure was gained. To ensure that the students were not disadvantaged, material from the database was distributed in printed form.



In February 2004 the Brinkster prototype was moved to a New Zealand site (<http://is-research.massey.ac.nz/verhaart/>) as part of ongoing PhD research (this server was decommissioned in early 2007).

By April 2005, the prototype had nearly 200 identified users (this excluded those who used the guest login, which was used approximately 300 times). Much useful feedback was obtained which formed the basis of the current prototype.

It should be noted that this prototype (V/2-Online) was phased out during 2006.

### **5.3.2.1.1    *Brief tour of the V/2-Online prototype***

In order to understand how this research and associated research questions evolved, this section will describe the V/2-Online prototype and issues that arose.

#### **Building the taxonomy**

The taxonomy in this prototype defines the structure of the content, and provides a container for the content. A “backbone taxonomy” (Guarino & Welty, 2002) managed the overall ordering and linking of the snippets, and operated in a similar fashion to a book index. Figure 5-3 illustrates an extract of the taxonomy on capturing meta-data.

## V/2-Online: Taxonomy

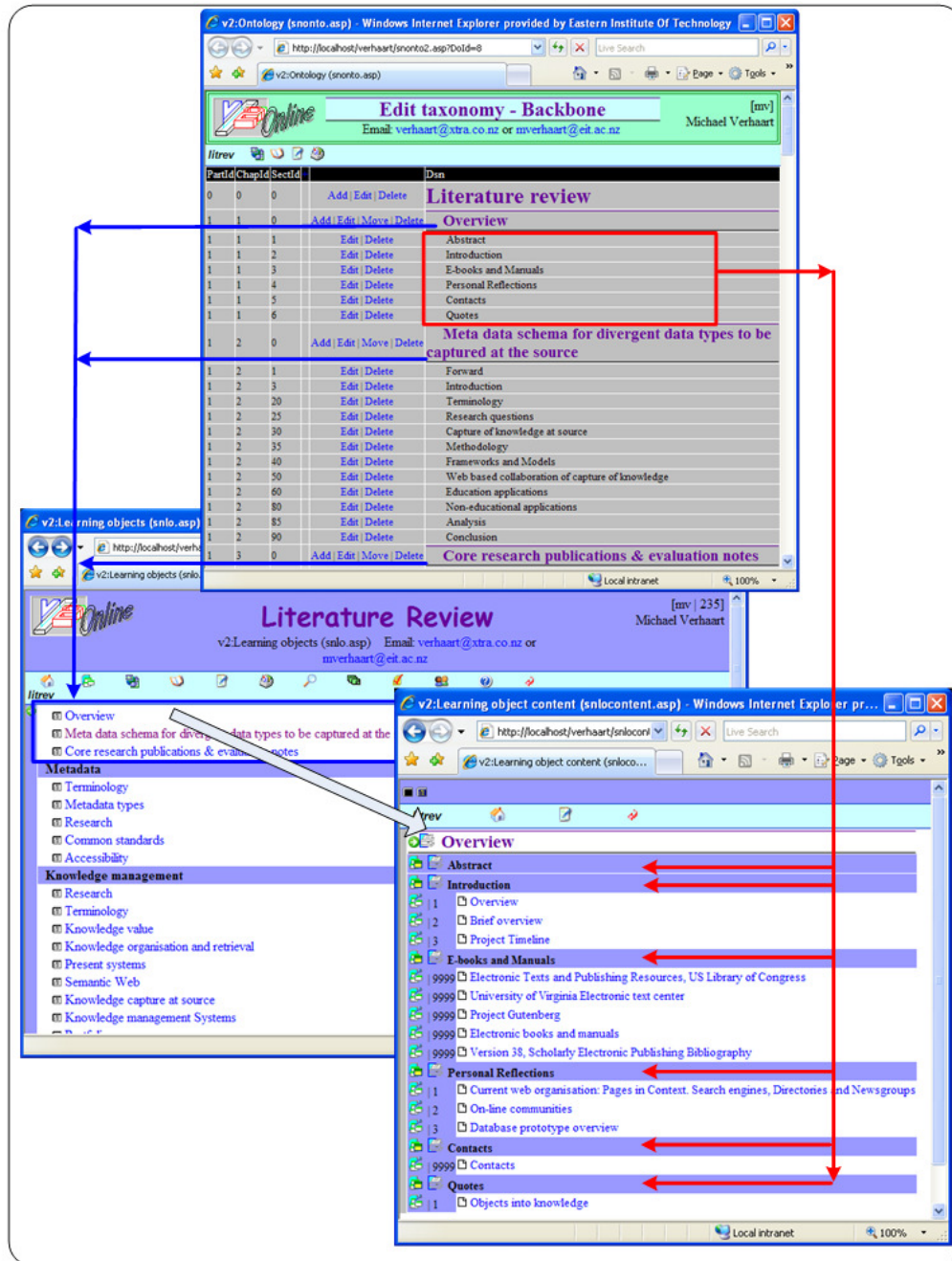


Figure 5-3: Extract of a taxonomy for a literature review

The structure is managed using the three left most columns: part, chapter and section. Each record in the taxonomy has a unique identifier, the BkDivId, and it is to this identifier that a snippet would be attached.

## **Adding and displaying the snippets**

Once the taxonomy was created the snippets were added using the add/edit form (Figure 5-4). Entries included: division (which links to the taxonomy); title; text description (used for student handouts); summary (which is used for the overhead projection and if missing, the full description would be used); identifiers that provide links to a bibliography; a multimedia element; and an audio element (which can be played as a background sound). Additional features included were a date when the snippet was to become available (flag date), and a side-note feature allowing for additional content to be displayed (including an image) alongside the content.

In order to keep data entry simple, the content was entered in as ASCII text, with a coded system to identify basic formatting such as bullets (line starts with \*) or numbers (starts with +). Text could be entered using standard html tags if features, such as bold, are desired.

## Snippet: Creating and viewing

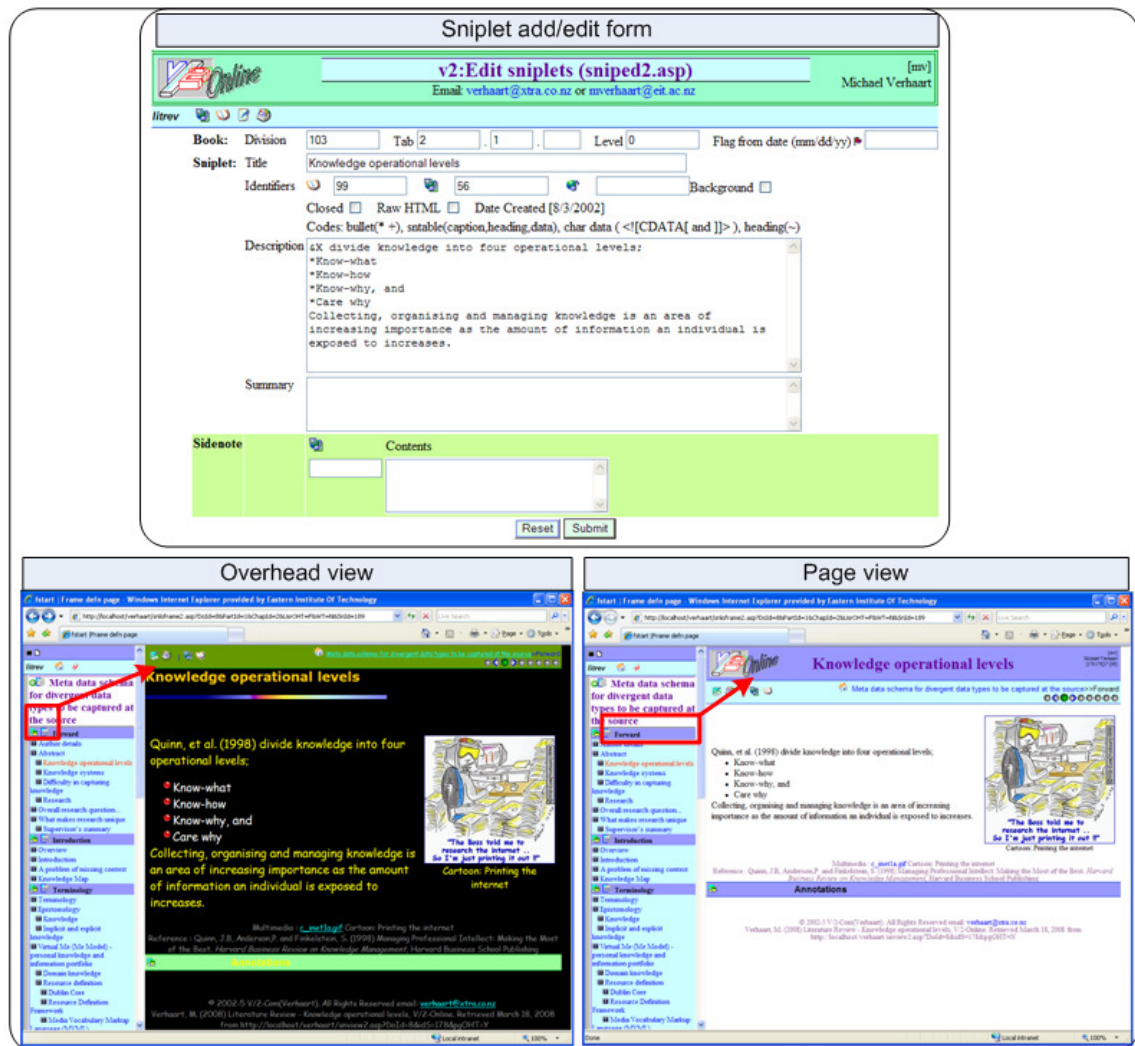


Figure 5-4: A snippet is added/edited in the top form and displayed either as an overhead (bottom left) or in page view (bottom right).

Once saved, the snippet data could be displayed either in a notes view or in a presentation (OHT) view (Figure 5-4).

One issue that was resolved in the database snippet prototype was that of printing lecture notes. In the static version of the content management system, students were required to select each page one by one and print out separate pages. This was both a time consuming exercise and created a lot of pages often with very little content. Using the database allowed content records to be combined into a format suitable for printing.

Text is not the only medium used to deliver teaching material though it has many advantages over other media, such as: compactness, easily editable, translatable, and searchable. Standard HTML caters for a multimedia rich environment by linking to external media elements. The V/2-Online prototype used a reference table that stored data about each multimedia element, such as a description that was used to automatically generate the alt tag in the viewable html page, and this was attached to the snippet.

This stage in the action research suggested an important area for further research, which was the ability to attach a metadata file to a media element containing descriptive information that could be used to automate the display of the element. This led to research into existing metadata standards such as the Dublin Core (2008b), and the Resource Definition Framework (RDF), and to the development of what was to be called the multimedia object (MMO) and a media vocabulary markup language (MVML), and is covered later in this thesis.

### **Managing references**

As content is often constructed from many sources, referencing is important. Products such as Microsoft Word 2007 and the Microsoft Word add-in end-notes (EndNote, 2008) provide some of the facilities especially in the area of both in-line and bibliographic referencing. The ability to add bibliographic references is therefore desirable, and a reference entity (table) was created in which the data could be entered. Figure 5-4 displays how a reference identifier (value 99 towards the top of the screen) is attached to content. The add/edit form used for entering bibliographic data is illustrated in Figure 5-5 (upper screen).

The ability to save and link to a local copy of the actual source document proved to be a useful function, especially where it existed in an electronic format. For a reference sourced from a web page this can be critical, as often these are moved from the original location. Google manages this by retaining a copy of all pages that are indexed in a cache.

## Bibliography: Creating and viewing

### Bibliography add/edit form

**v2:Bibliography (snrefmtc.asp) - Windows Internet Explorer provided by Eastern Institute Of Technology**

http://localhost/verhaart/snrefmtc2.asp?DoId=88&RefId=205&Act=Mod

**Literature Review** [mv | 235] Michael Verhaart

Modify Bibliography Email: verhaart@xtra.co.nz or mverhaart@eit.ac.nz

**Id** 205

**Title\*** An Extensible Content Management System using Database and Internet T (required)

**Creator** Verhaart,Michael and Dr. Kinshuk

**Creator Email** mverhaart@eit.ac.nz

**Date Created (any format)** 2003

**Date Retrieved (mm/dd/yy)**

**Inline Ref (&x, &X)** Verhaart, M. and Kinshuk, Dr.,2003

**Hard Copy description (eg book name)** Edmedia2003, Hawaii.

**Web URL (format: #.url.#)**

**SnRFormat**

**Local URL of file in folder snsrc** 2003VerhaartKinshuk\_edmediav3.doc

**Access rights for local (snsrc) copy** ☐ [L]ocked, ☐ [P]ublic

**Publisher** IEEE Computer Society

**Reference type** HA | Hardcopy Author

**Notes**

Reset Submit

### Displaying bibliography

**Maintain References/Bibliography** [mv] Michael Verhaart

Email: verhaart@xtra.co.nz or mverhaart@eit.ac.nz

litrev

Reference style [RA] Search [Extensible] Search One word searches only

RefId	Add	Reference
322	Edit	Steve Cazyer (2004, Dec) The blogosphere: Semantic blogging and decentralized knowledge management. <i>Communications of the ACM</i> , Volume 47 Issue 12, pp 47-52, ISSN:0001-0782 ACM { L   2004-12Cazyer_CACMSemBlog.pdf }
154	Edit	Tinsler,D., Lepani, B. and Mitchell, J (1996) Education and Technology Convergence: A Survey of the Technological Infrastructure in Education and Professional Development and Support of Educators and Trainers in Information and Communication Tech. , NBEET. Commissioned report no 43. Canberra AGPS
148	Edit	Verhaart, M. (2002, Sep) Massey University, Six-Monthly Doctoral Studies Report. , { L   2002Verhaart_6NthReport10Sep.doc }
205	Edit	Verhaart,Michael and Dr. Kinshuk (2003) An Extensible Content Management System using Database and Internet Technology. <i>Edmedia2003, Hawaii</i> , IEEE Computer Society { P   2003VerhaartKinshuk_edmediav3.doc }
333	Edit	x (n.d.) xx, x.
105	Edit	Zack, M. (1998, Sept) Managing Codified Knowledge. <i>Sloan Management Review</i> , Volume 40, Number 4, Summer 1999, pp 45-58.
199	Edit	UK Common Metadata Framework 0.1 draft (n.d.), { L   2003ukcmf_v0p1.doc }
36	Edit	The Future of Computing: Let Battle Commence (02/16/02). Vol. 362, No. 8260, P. 64, Economist { L   Economist_com_netvJava.htm }
100	Edit	The New Hamlyn Encyclopedic World Dictionary (1988), Hamlyn, London
170	Edit	Contents (1999, May). In Britain, Premier Magazines in assoc with British Tourist Authority. ISSN 0019-3143
8	Edit	Neilsen, Jakob (1995?) Multimedia and Hypertext. The Internet and Beyond, SunSoft, Mountain View, California. AP Professional

Associated snippets

- 45 Definition
- 46 Structures
- 47 Integration of technologies
- 48 Money saving benefits

Figure 5-5: Metadata for a bibliographic reference

A key requirement was that the attributes (fields) making up the bibliographic metadata could be re-constructible into a standard referencing format such as that from the American Psychological Association (APA).

This was managed via a template, and as an example the data in Figure 5-5 was formatted to an APA style as:

```
"Verhaart, Michael and Kinshuk (2003) An Extensible Content  
Management System using Database and Internet Technology.  
Edmedia2003, Hawaii, IEEE Computer Society { P |  
2003VerhaartKinshuk_edmediav3.doc }"
```

Once the bibliographic data was captured it could be displayed in a list as illustrated in Figure 5-5 (lower screen). Figure 5-5 demonstrates the following features:

- the transformation of the data into an APA style reference. The use of a formatting string, discussed earlier, allows for style modifications;
- a link to a local file is shown in the {}, with a L (local) or P (Public) prefix showing access rights. {P | 2003VerhaartKinshuk\_edmediav3.doc}; and
- the use of database technologies allows additional functionality including:
  - a search facility; and
  - linked relationships to snippets that use this reference. The icon to the right of "Edit" indicates that this entry is used by one of the snippets (otherwise it is left blank, Ref 105) and clicking on the icon will display snippets' associated.

As a result of this approach reverse linking was possible, where if all the bibliographic entries were displayed, the associated snippets could also be displayed. This is illustrated in Figure 5-5 (bottom).

### **Annotations as questions**

In a teaching and learning environment assessment plays a significant role. In this prototype provision for a question annotation was made, and was created by starting the annotation with "Q:". This meant that questions



could be attached directly to an annotation, and when students wanted to view only questions the prototype would display only those annotations starting with a “Q:”. When the students wanted the answer, they could click on the Snippet id and be linked back to the snippet. This is illustrated in Figure 5-6.

### V/2-Online Annotations as Questions

The figure illustrates the V/2-Online Annotations as Questions system through three screenshots of a web application.

**Top Screenshot: Database Management Systems**  
 The page title is "Database Management Systems" by Michael Verhaart. It features a sidebar menu with categories like "Introductory DBMS", "Modern Database Management 6th Ed", and "Advanced Topics". A red arrow points from the "Modern Database Management 6th Ed" section to the middle screenshot.

**Middle Screenshot: View questions**  
 The page title is "View questions". It displays a list of questions under the heading "Snippet(Question)". A red arrow points from one of the questions to the bottom screenshot.

**Bottom Screenshot: Archiving**  
 The page title is "Archiving". It contains a section titled "Annotations" with a table showing a list of annotations. A red arrow points from a question in the middle screenshot to this table.

**Annotations Table:**

Annotations	Userid	Action	Date	Note/Reference	Rating
3	1	Delete   Edit	5/10/2003	2/25/2003 Q: Explain what is meant by Archiving the data. Give an example.	3

A callout box points to the "Annotations" table with the text: "Question as an annotation".

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Figure 5-6: V/2-Online A question annotation



## **Glossary of terms**

The provision of a glossary of terms was investigated, and with database capability, each term could include a translation to another language. The prototype was designed in a New Zealand context where international students come not only to learn the course content but also to improve their English, hence a full translation of a page is not desirable. To have some of the technical terms described in the student's language would be an asset. In the prototype, when a page was rendered, each word was checked against the glossary, and if a translation existed then a tool-tip was placed with the word. So, if students hovered their mouse over the word, the translation would appear. Although implemented in this prototype, the feature was not commonly used, so in the subsequent prototypes it was omitted.

### **5.3.2.2 Annotations**

A second key research area that emerged was the ability to acquire student information and knowledge through the use of annotations. This feature has become more common on the internet, with user feedback solicited in a variety of ways. For example, web sites of digital cameras ask users to rate their camera and provide a summary of their experiences (e.g., dpreview (2008)). Research using the snippet database was focused on capturing student knowledge, and is a core feature blending face-to-face and online delivery.

At present many systems allow the users to interact with the lecturer via email or bulletin boards. One significant drawback of these approaches is that the discussion can quickly lose context. In a discussion list, for example, it is not uncommon for many threads to be happening simultaneously and each thread to be interlaced. The snippet management prototype, however, allowed annotations to be added directly to the snippet. Figure 5-2 displays an annotation that was entered by a student and reply from the teacher to indicate that the snippet reflects the changes suggested.

The problem statement associated with the annotation framework was “*can a framework be developed that allows other people to add information and knowledge that will benefit all users of the system?*”

A pilot study into the annotation framework (which is part of the V/2-Online framework) was done using the V/2-Online prototype and was summarised in Verhaart and Kinshuk (2005b).

The prototype allowed users to access the system as guests or to create user profiles. Initially guests had some limitations, such as, the capability to printout a sequence of snippets, however, so that students would not be disadvantaged when they forgot their passwords, these restrictions were later removed. The main difference between guest access and user profile based access was the ability to provide a level of customization for the user and from the research perspective, the ability to analyse and track individual user movements. Users were able to create anonymous accounts as they chose their own user identifiers, and data that could be used to identify them, such as their name and email account, was optional.

The logs of V2-Online showed that from 2002 until October 2004 there were over 150 distinct users and an unspecified number of guests (logs show that guests logged into the site over 200 times). This included the group surveyed in the IFETS discussion. Guests would range from those who accessed the prototype to “have a preview” to students who did not wish to create user profiles. By January 1, 2006 the number of unique user profiles created was the 219, with the guest account accessed 320 times.

It is not possible to provide exact numbers as some students forgot their passwords and generated new accounts with different user identifiers.

As described in the previous chapter, annotations could be attached to a snippet (Figure 5-2). To address the problem statement there was a need to assess the value of the annotations added by users. In order for this to be accomplished a classification scheme was developed identifying the type of

## Chapter 5

annotation, such as, whether it was information or knowledge, in-context or out of context. Results of classifying the annotations are listed in Table 5-2.

Table 5-2: Annotation analysis codes with examples

Code	Type	Example
CC	Correction /Modification in Context	hi Michael you have spelled template wrong on this page it is stemplate.
CX	Correction /Modification out of Context	
IC	Information in Context	Touted as the best sites on the Net: <a href="http://whatis.techtarget.com/definition/0,,sid9_gci331047,00.html">http://whatis.techtarget.com/definition/0,,sid9_gci331047,00.html</a>
IX	Information out of context	A good site for Adaptive Technology <a href="http://www.dclab.com">www.dclab.com</a> (put in wrong place)
KC	Knowledge in Context	The introduction of voice chat will lead to better security as the user will be able to get an idea as to who they are chatting with, e.g. male or female and a guess at the possible age.
KX	Knowledge out of Context	
QC	Question in context	Michael, you could add something here about the court case against Microsoft - for their (monopoly?) market share. Lisa:)
QX	Question out of Context	im finding it hard to get information on FRAMES. (put in the wrong place)
SC	Social in Context	
SX	Social out of context	Hi From Nxxxx
O	Other (Note, comment, ...)	AOL owns the Internet!
RF	Reference	Note: In the original design a snippet allowed for only one reference. As a work around a special type of annotation was created to allow multiple references to be added to a snippet.

Based on the data collected, two domains used to teach a theory component were analysed. It should be noted that students in the *Internet and Web Design* class were required to create an annotation as part of an assessment, so this has the potential to skew results. For this analysis no attempt was made to separate assessment and voluntary annotations, although reviewing the results did not highlight any noticeable differences. This could

be an area for further research. Annotations for the two domains are shown in Table 5-3 and a graph of the data is shown in Figure 5-7.

Table 5-3: Annotations added in V/2-Online

Code	Type	Multimedia (Optional)	Internet (Mandatory)
CC	Correction/Mod in Context	6	9
CX	Correction/Mod out of Context	0	0
IC	Information in Context	4	15
IX	Information out of context	2	8
KC	Knowledge in Context	3	12
KX	Knowledge out of Context	0	0
QC	Question in context	0	7
QX	Question out of Context	1	3
SC	Social in Context	0	0
SX	Social out of context	1	2
O	Other (Note, comment, ...)	5	10
RF	Reference	2	0
<b>Total</b>		<b>24</b>	<b>66</b>
<b>Distinct Users</b>		<b>68</b>	<b>84</b>

It can be seen that *information in context* and *knowledge in context* were the most frequent uses of the annotation prototype, followed by *questions in context*.

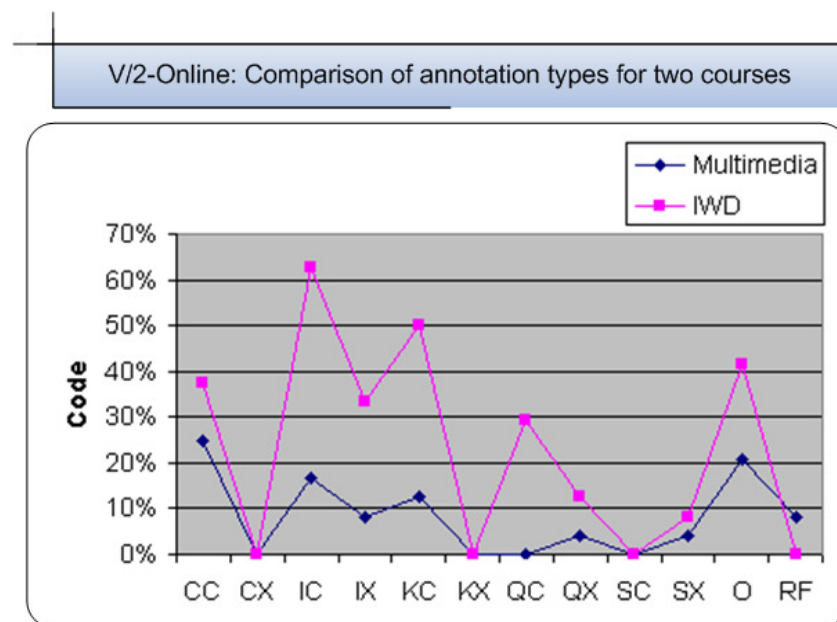


Figure 5-7: Comparison of annotations in two domains

Verhaart and Kinshuk (2005b) considered two questions related to the annotation framework. Firstly, *"if a mechanism is provided to add annotations, will students and visitors use this to share information and knowledge, and provide a tool to solicit assistance?"* In the case of the multimedia course where there was no requirement to add an annotation, just under half of the multimedia visitors added some type of annotation. Obviously this was much better in the Internet and Web Design course when students were asked to add an annotation as part of an assessment.

Secondly, *"will the annotations entered provide a mechanism for the students and visitors to seek assistance?"* it was seen that 11/90 or 12% of the annotations were questions, and the majority of these remained in context. So this indicated that the prototype was capable of allowing students and visitors to seek assistance.

An interesting observation from the analysis was that out of context annotations were commonly placed on the first page of the domain content.

### **5.3.2.3 Learning/Content management systems**

The V/2-Online prototype was used between 2002 and 2005. Students were involved in discussions regarding functionality and usability, and based on actual experience and user feedback, modifications were made. These included:

- Adding the ability to navigate using a PowerPoint electronic pointer to assist when delivering as an overhead;
- Adding the ability to show associate snippets for bibliographic entries;
- Adding and extending the snippet formatting codes ( \*, \*\*, +, ++ and the & codes to allow automatic citing of bibliographic entries);
- Adding search functionality;
- Adding the sidebar functionality to improve content display;
- Adding a question annotation type;
- Adding the glossary of terms and translation functionality; and

- Developing the initial design of the multimedia object (MMO).

### 5.3.2.3.1 Tracking movement and usage

As each snippet was visited, this was recorded by the prototype against each user (often referred to as “crumb collection”), and meant that a student could view which snippets were visited most often. At the system level, all user crumbs could be aggregated to give a usage pattern (Figure 5-8). This enabled analysis of most frequently accessed individual snippets and could highlight importance or a difficulty of understanding,

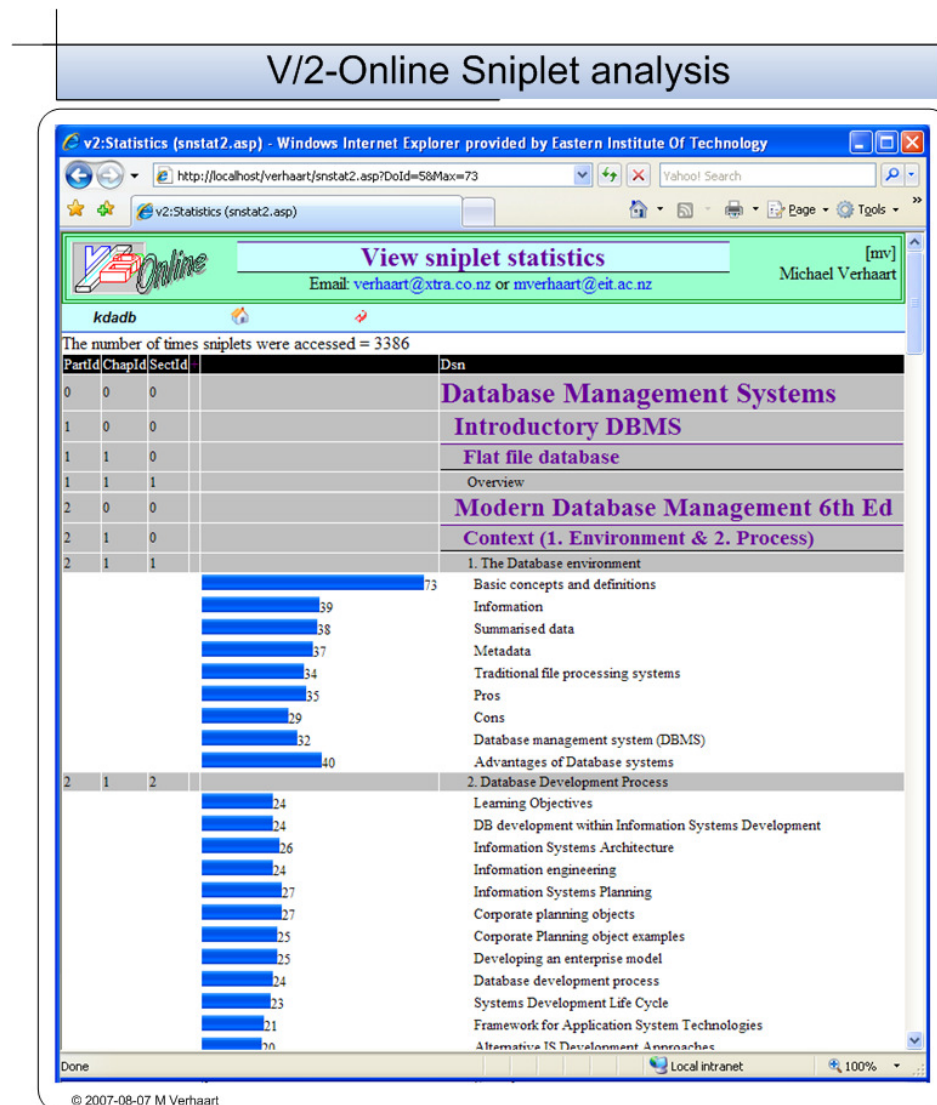


Figure 5-8: V/2-Online Analysis of snippets

Usage was also monitored and a graph showing the last access date and the number of times each user accessed snippets could also be generated (Figure 5-9).

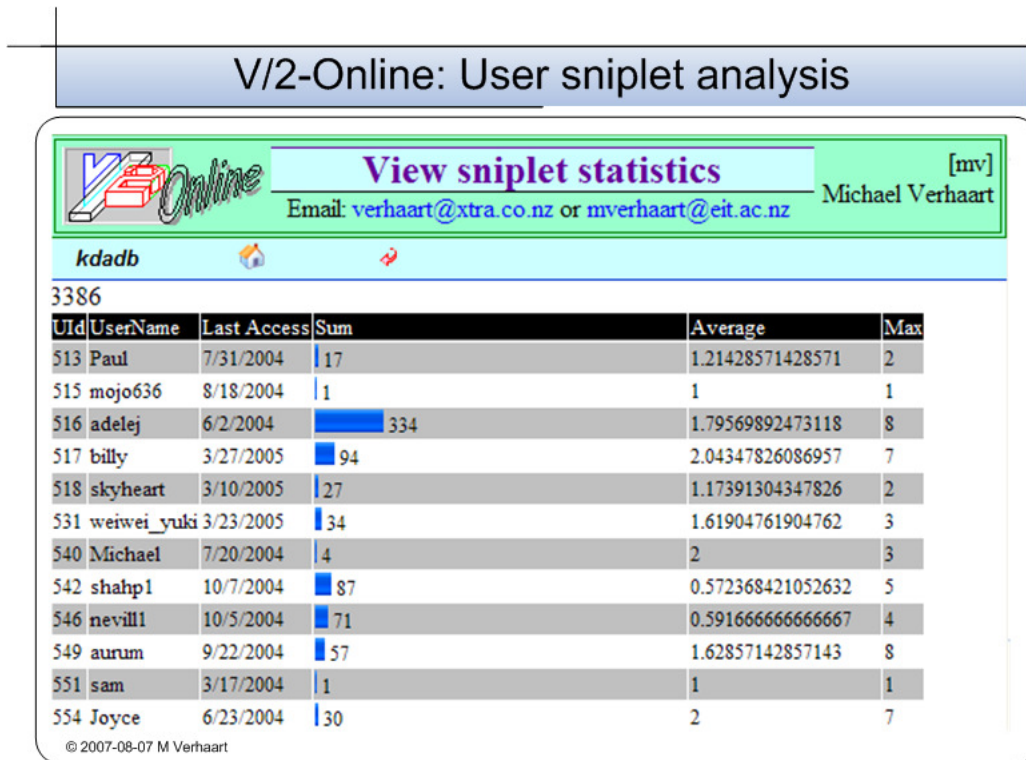


Figure 5-9: V/2-Online Analysis of snippets by user

### 5.3.3 Identified features and issues

From the research using the V/2-Online prototype, the snippet model was developed and had the following features:

Table 5-4 lists the features identified as important during this action research cycle.

Table 5-4: Important features identified from cycle two of action research

<p>Information and knowledge acquisition (Context and collaboration)</p> <ol style="list-style-type: none"><li>1. An association in a backbone taxonomy to give the snippet context.</li><li>2. A possible association with alternative taxonomies, for example, a snippet on multimedia could be relevant to other domains such as; internet, database, electronic design and photography.</li><li>3. A mandatory title, and creation of auditing data (such as date and author).</li><li>4. A description and optionally a summary that is used to display the snippet as an overhead, and if the summary is missing, the description is substituted.</li></ol> <p>Mechanisms for acquisition, management and dissemination of information and knowledge</p> <ol style="list-style-type: none"><li>5. The ability to link to digital assets including multimedia elements and bibliographic entries</li><li>6. The ability to link annotations (key to the capturing of knowledge, both from the owner and from the users).</li></ol> <p>The snippet model may optionally also contain:</p> <ol style="list-style-type: none"><li>1. Flags to manage deletions and permissions (e.g., the snippet can be available only to the owner of the system); and</li><li>2. A date to hide the snippet until the date specified is reached.</li></ol>
---

## 5.4 Conclusion

The V/2-Online architecture described previously (Figure 5-1) evolved into that illustrated in Figure 5-10.



## Chapter 5

By the end of this prototype phase, references and multimedia were being combined into a common structure, which was to eventually be named a multimedia object (MMO). In order to achieve this, a metadata language was created in XML that contained the descriptive data necessary to create associated descriptors, and in the final stages of the V/2-Online prototype this was implemented for some of the media elements (e.g., the sidebar images on the menu pages). This will be described in further detail in Chapter 8. In this prototype, the multimedia, reference and glossary structure were retained to maintain backward compatibility (Figure 5-10).

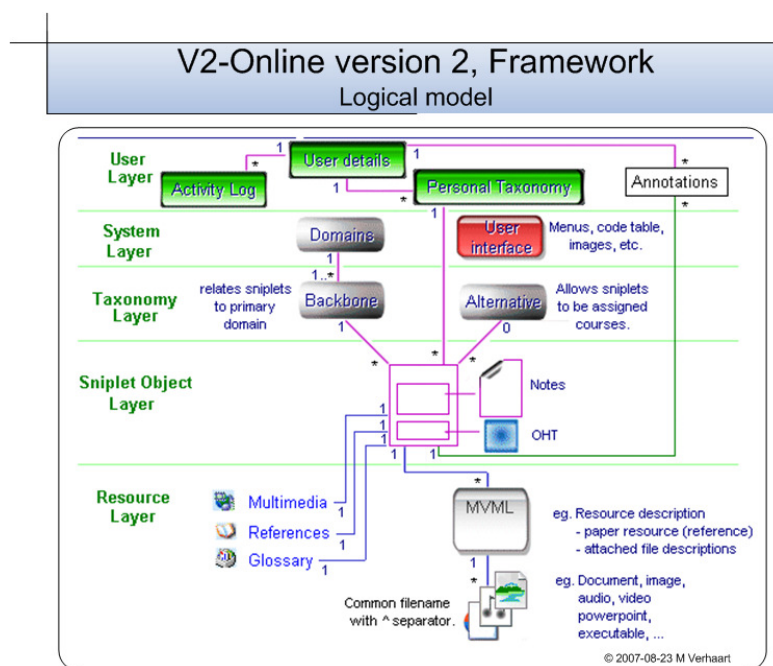


Figure 5-10: V/2-online framework, (final iteration)

The preceding chapters described the evolution of the problem statements to be addressed by this thesis. In the context of a teaching and learning environment the chapters covered the progression from: computer based display technologies (PowerPoint to Help files to LCD projectors), static web based technologies, to interactive database driven web technologies.

This chapter summarized published research based on the V/2-Online prototype and identified the origins of the virtualMe framework, the annotation framework and the multimedia object mode (MMO).

## 6            **Action research cycle three: The virtualMe framework**

The previous chapters described a series of prototypes used to develop the overall research question: “*Can a metadata schema be developed to enable the acquisition of information and knowledge in context at source in a teaching and learning environment?*”, and to provide direction for the research.

As discussed earlier, acquisition, management, organisation and dissemination of an individual’s data, information and knowledge can be achieved using electronic technologies. In particular, the ability to use Internet technologies allows this knowledge hierarchy to be managed in a way that facilitates the construction by the individual, and also the dissemination and interaction by external entities.

A framework supporting this research has been developed, and since it is centred on an individual, in this case an instructor (lecturer or tutor) the term **virtualMe** (Verhaart & Kinshuk, 2005a) was coined. Figure 6-1 illustrates a context diagram showing the interaction of the virtualMe with external entities namely: students and external users such as colleagues, family and other internet visitors.

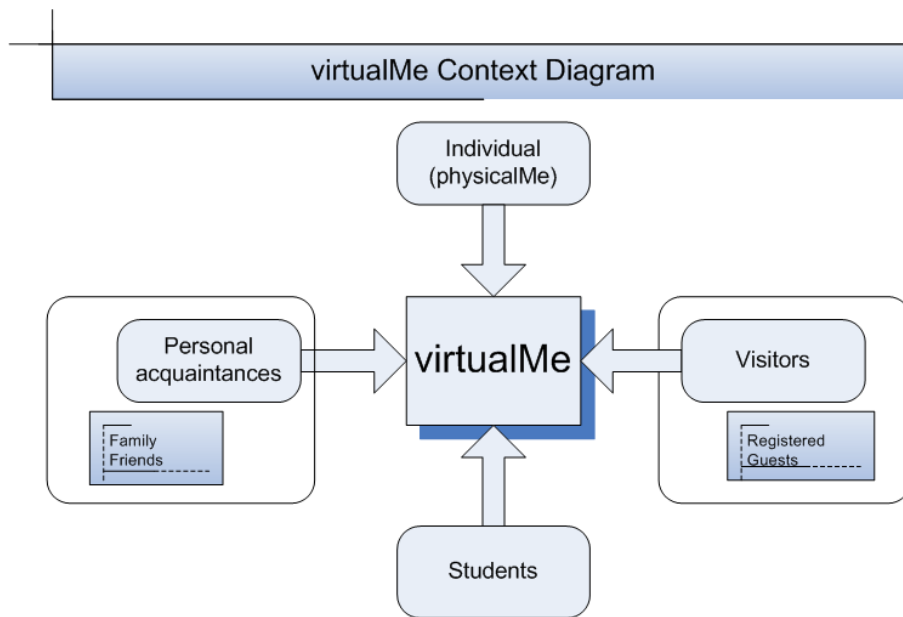


Figure 6-1: virtualMe Context Diagram

This final phase of the action research developed and tested concepts based on the virtualMe framework. The dynamic prototype provided proof that the actual virtualMe framework was both feasible and workable.

## 6.1 Methodology

### Sample

Teaching and learning content from the previous prototype was converted and updated. In order to determine the perceived usefulness of the proposed framework a survey of users and potential users was sampled.

### Procedures

A new prototype was developed to test the structures and concepts proposed in the virtualMe framework. There were many challenges in the implementation of this prototype, such as a need for the previous prototype needed to remain intact as the content was being actively used by students. The user profile data, such as a user's password, name, and configuration preferences, were shared between both this and the previous prototypes. Further, as some of the content was in a state of change (e.g. software

applications were having version changes), both the old and new versions needed to be available to students. An additional challenge was that the software used to develop the online prototype (ASP) underwent a significant change to the Microsoft dot net (ASP.net) framework.

Once the prototype was developed to a usable stage with appropriate content, the prototype was used to deliver courses and students were encouraged to access the content for their courseware. As before, to provide an extensive test environment, multimedia, Web design and database content was used.

## **Instruments**

To evaluate the virtualMe framework, in the first instance an ASP.NET prototype was developed used to support teaching of multimedia, Web Design and Database courses. A survey tool was developed and two user groups were surveyed: Past and existing students, and peers that could give constructive feedback onto the perceived usefulness of such a framework. As the prototype was in constant evolution, informal student feedback based on actual usage, was used to enhance the prototype.

## **6.2 Design of virtualMe framework**

### **6.2.1 Overall framework**

The purpose of the virtualMe framework is to provide an environment suitable for a blended teaching environment that allows research into the acquisition of knowledge in context at source. To enable this functionality the following features have been considered desirable:

1. Personal data, information and knowledge need to be added in a controlled and consistent way.
2. Personal content needs to be arranged and organized in a logical way.

3. Access needs to be by: person, visitors (students, registered visitors - such as family, friends and possibly other people unknown to the person), and guests.
4. Interaction with the system for visitors is by annotating in context.
5. Chunks need to be “contextualized” and annotated in their context.
6. A user interface which:
  - reflects the personality of the owner of the portfolio (customisable and adaptable); and
  - be user adaptable.
7. Benefits in a teaching and learning environment, including functionality to be:
  - a teaching delivery mechanism;
  - a self study (online or offline) assistant; and
  - used to display material for discussion on a data projector.
8. Able to convey a sense of “interacting with a person” in a “community”.

This is illustrated as a rich picture in Figure 6-2.

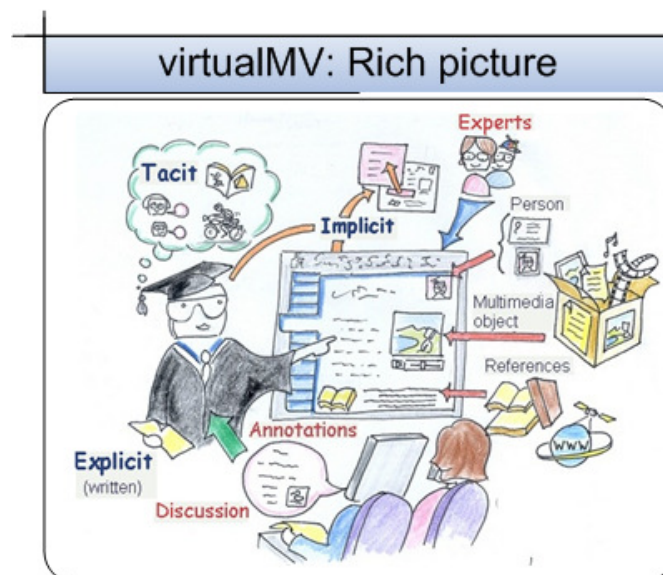


Figure 6-2: virtualMe: Data, information and knowledge acquisition management and distribution framework.

Based on the action research, a framework illustrated in Figure 6-3 evolved, that includes a structure for:

- managing and tracking user details;
- organizing the information and knowledge (taxonomy);
- storing information and knowledge (a snippet model);
- managing the digital assets (a Multimedia Object or MMO), described using a Media Vocabulary Markup Language (MVML);
- acquiring context focused information and knowledge from users (annotation framework); and
- a presentation layer.

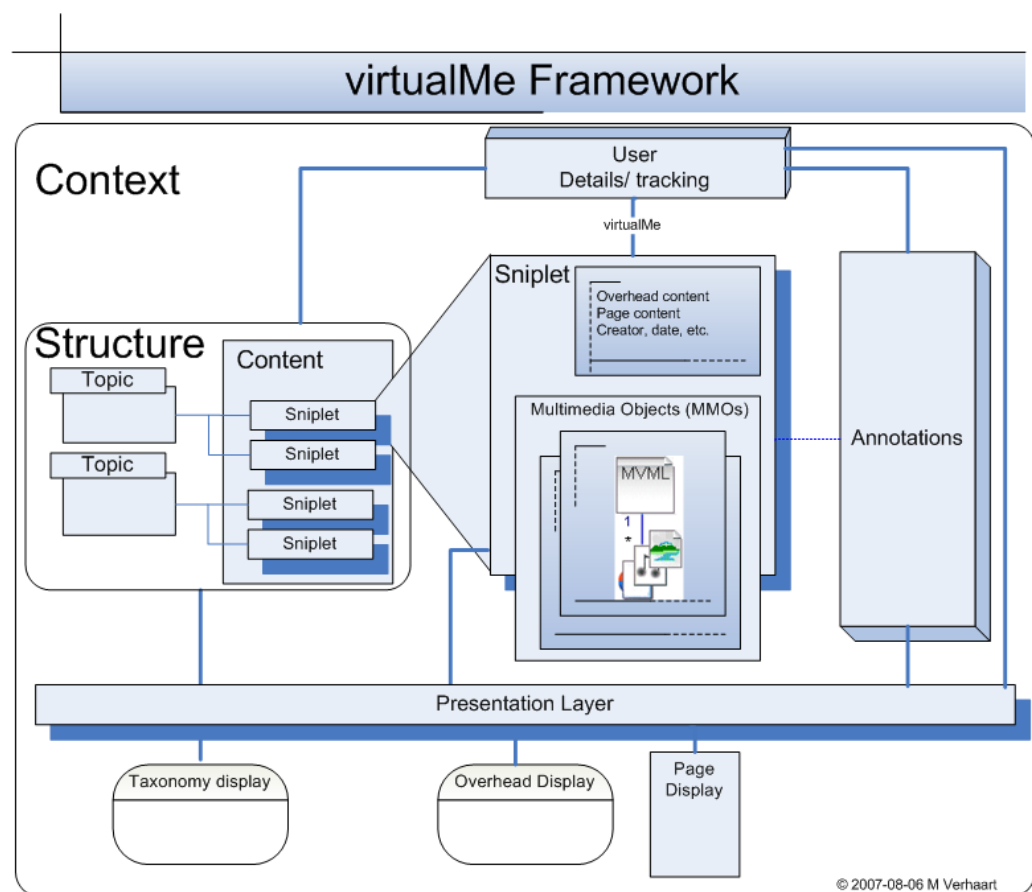


Figure 6-3: virtualMe Framework

Information is most useful when it can be placed in its correct or original *context*, and problems can occur when this context is lost, as is common

when sourcing material from the Internet (Verhaart & Kinshuk, 2006a, p. 52).

Keeping track of *users* and ownership is an important part of a shared information and knowledge system. The virtualMe is centred on an individual's information and knowledge, and this "master user" creates, controls and moderates the core content, while annotations are used to capture user comments.

*Structure* is the organisational part the framework. Most often this is in the form of a basic taxonomy which allows the content to be logically classified.

*Content* is the fundamental building block of the framework. Verhaart (2002) discussed the development of an appropriate content granularity, and from the action research proposed a suitable content fragment coined as a "snippet", which was defined as "*a piece of knowledge or information that could be represented by one overhead transparency*" (Verhaart & Kinshuk, 2003, p. 153).

The snippet can be made up of a textual description plus additional *media elements*, (digital assets) such as, images, sounds and videos, and these can be reused by multiple snippets. When reused the original context of a digital asset can be easily lost. In addition, the usefulness of the digital asset could be enhanced if it could be represented in a variety of ways, for example, an image of a person would be significantly enhanced if additional information could be attached. A metadata file containing the person's details, an image of their business card, a voice file giving the correct pronunciation, and possibly curriculum vitae would all improve the context of the image.

The concept of wrapping multiple files into an object is being implemented in many emerging technologies, and in the web environment, the metadata is often centred on XML. Examples include the Open Document format in Open Office, the docx file in Microsoft's Word 2007 and gadget files in Windows Vista. In order to identify the digital object with multiple

representations the term multimedia object (MMO) was coined (Verhaart, Jamieson & Kinshuk, 2004, p. 513).

*Annotations* can be used to extend the information and knowledge and facilitate the “social interaction” required to generate knowledge. Verhaart and Kinshuk (2006b) described an annotation framework that includes both out of context (such as global comments) and in context (added to snippets) annotations.

A layer based logical model has been developed, which can be viewed from the perspective of how a user would see the system and is illustrated in Figure 6-4.

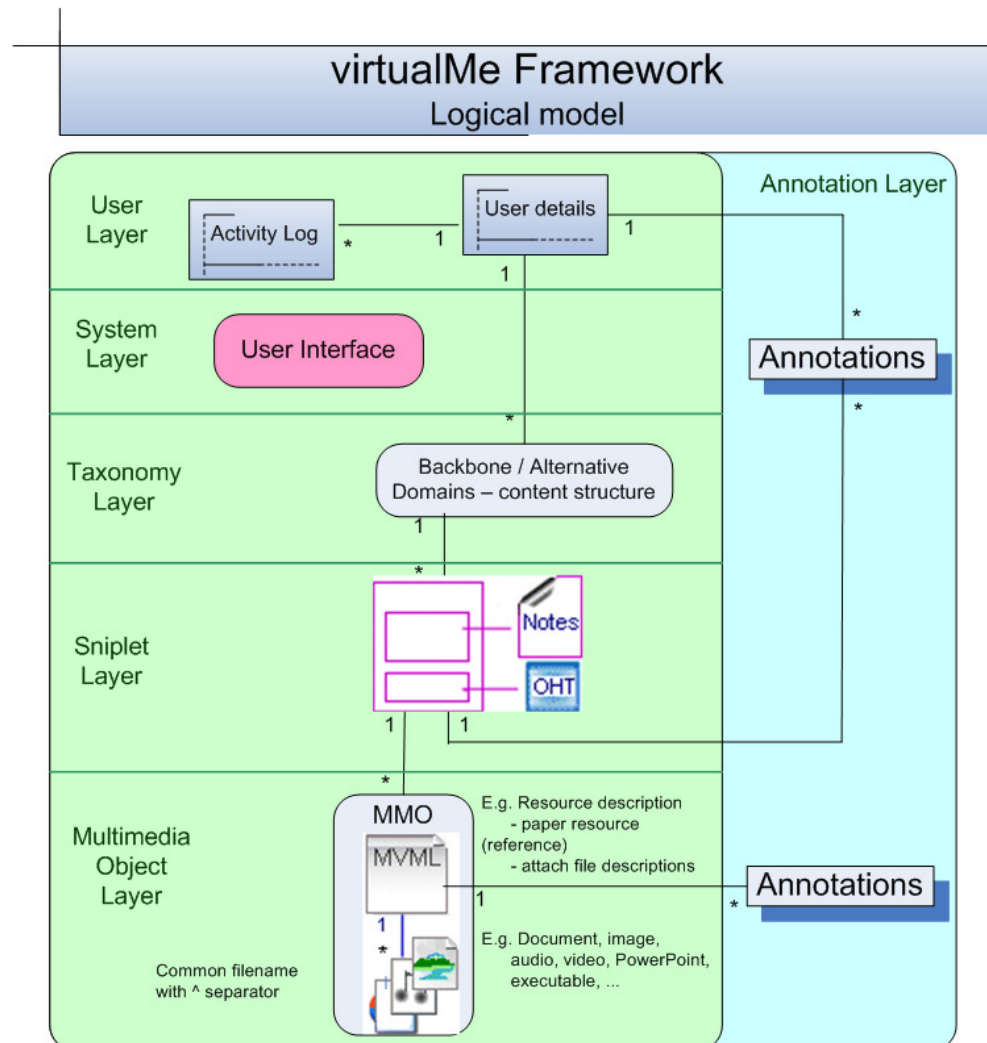


Figure 6-4: virtualMe Framework: Logical model



Figure 6-5, illustrates the translation of the logical model into a three tiered framework typical of internet based implementation: Web client, virtualMe application and database services.

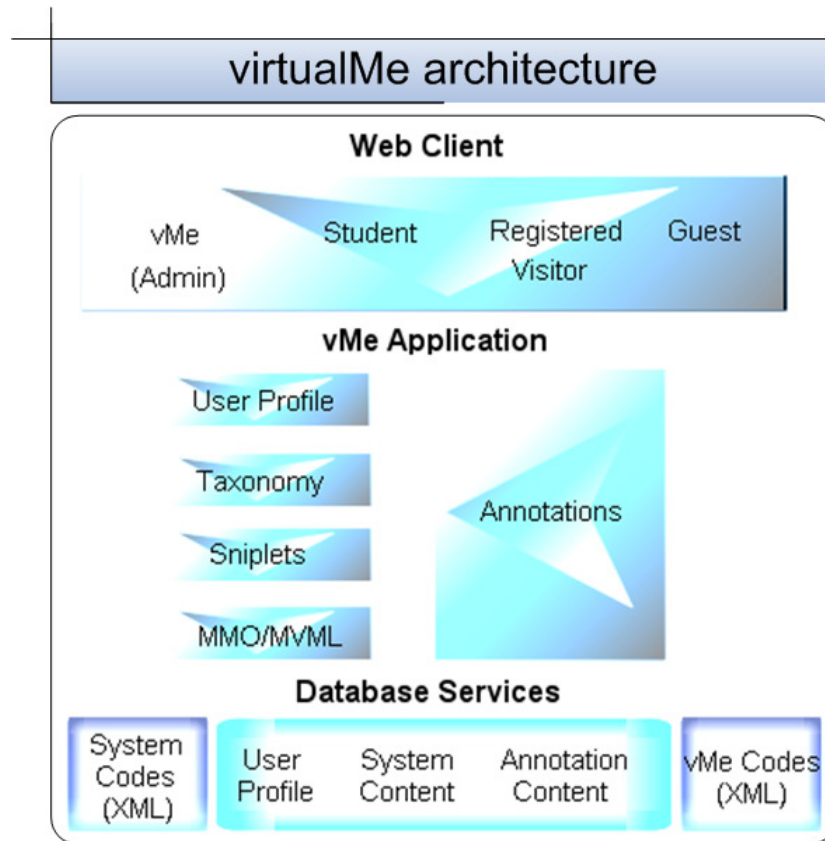


Figure 6-5: virtualMe architecture

The **Web client** tier is managed via an Internet browser, and provides the interface allowing the virtualMe to be displayed to the various user types.

The **virtualMe application tier** includes all the logic required to access the virtualMe. A user profile has been used to ensure the security and integrity of the system, and maintain settings of user permissions for controlled access to folder areas. The taxonomy manages the structure, the snippets are the content "chunk" and the Multimedia Object/Media Vocabulary Markup Language (MMO/MVML) manages the digital assets. Finally the annotations allow information and knowledge to be captured in the system.

**Database services** make up the third tier, and while the framework focuses on building a system for an individual, the ability to extend a system to include multiple individual virtualMes was considered. This allows for the development of a community of individuals which is how social structures are represented in the real world, and in time could be extended to allow for interoperability among the community.

### **6.2.2 Annotations**

Meisenberger and Seiwald (2002) indicate that knowledge is socially constructed, and this is in line with the use of social constructivism in education (McMahon, 1997). To enable this, an annotation framework was designed and implemented as a web assistant system (Aberg & Shahmehri, 2001).

The ability to capture the many types of knowledge possessed by an individual is an integral part of creating the virtualMe. In a physical sense, "I" would interact with other humans and have "my" information and knowledge expanded, modified or corrected. In order to have a system that captured information and knowledge the virtualMe needed to have this ability also, and this was achieved through the use of annotations (Verhaart & Kinshuk, 2006b).

The research question dealing with user annotations is:

*"Can a framework be developed that allows other people to add information and knowledge that will benefit all users of the system?"*

The question can be considered in two parts: firstly a framework needs to be developed, and secondly benefits to all users of the system need to be investigated.

As defined previously, information is facts that can be distilled from data, and can be thought of as *"data that is contextualized"* (Davidson and Voss,

2002, p. 101). In the virtualMe there are two possible contexts: the *global* context which is where information and knowledge are attached to the virtualMe itself and for the purposes of this research would be considered out of context; and the *local* context where this information and knowledge is attached to a snippet or Multimedia object.

Earlier discussion defined knowledge as “what *we* know” and as such is attached to an entity such as an individual or an organization. Knowledge can be classified in many ways but those considered relevant to this thesis are; explicit, tacit, and missing.

**Explicit** knowledge can be written down, so for example if a student reads a piece of content and knows that it is out of date, could add an annotation to this piece of content to first indicate it is out of date and suggest changes.

**Tacit (or implicit)** knowledge will occur in many ways, for example, if an annotation is added into the system and attached to a snippet it can *usually* be implied that it relates to the snippet (though this is not always the case). It would be of use in this research to consider whether an annotation is correctly contextualized. Tacit knowledge (Polyani, 1958) can be loosely considered as knowledge that is intuitive, and once written down becomes explicit. In practice, it is hoped that providing a framework to acquire, manage and disseminate information and knowledge would enable a person’s tacit knowledge to be explicated (turned into explicit knowledge) by association.

**Missing** knowledge is that which people should have to complete their work (Davidson & Voss, 2002). This can be achieved through the use of annotations, where users of the system can either indicate that content is missing, or add the missing content from their knowledge.

Hence, from an analysis point of view, explicit knowledge can be easily codified, and then whether it is in or out of context will give a notion of implicitness. So for example, an out of context knowledge annotation would

be where a student adds a general comment indicating something they know to any snippet, whereas knowledge in context could be a student providing a URL to a piece of content with the addition as to why this URL was mentioned. Without the comment the URL would be considered information.

With respect to the development of the V/2-Online prototype, a five tier annotation framework was developed (Verhaart & Kinshuk, 2005b; Verhaart & Kinshuk, 2006b) and was described as follows: “structured annotations occur in the framework on five tiers: global, content (snippet), thread, the element object (MMO) and derived.”

Initially it was envisaged that "external" individuals would be able to add core knowledge in the model, but on reflection this was discarded as a personal information and knowledge system needed to be moderated by the individual whose information and knowledge was being captured. In the V/2-Online prototype the domains were physically separated whereas in the virtualMe framework domains were consolidated to allow for snippet sharing. The annotation framework was modified for the virtualMe and is illustrated in Figure 6-6.

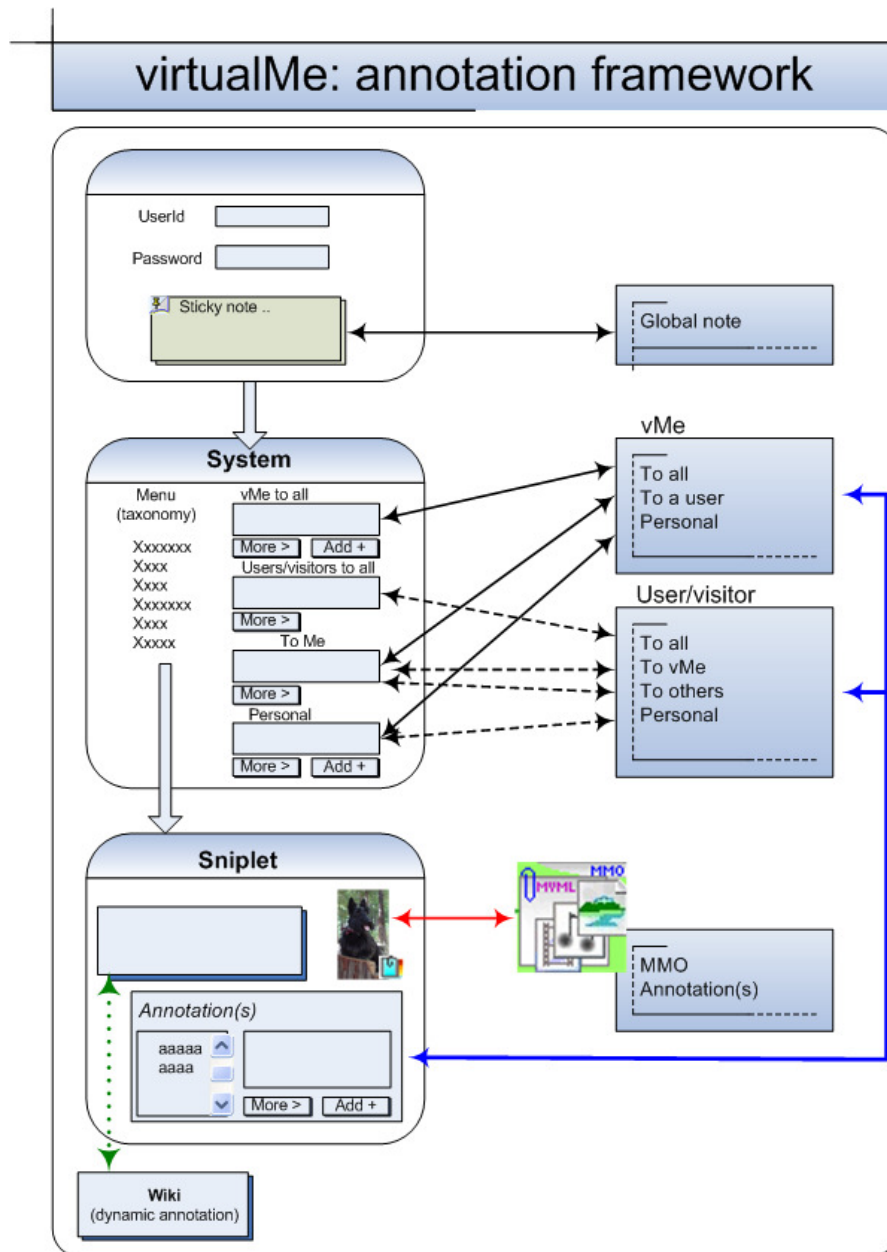


Figure 6-6: virtualMe annotation framework architecture

The virtualMe annotation framework includes several capabilities:

- a global comment can be created to notify all users before logging in;
- annotations can be added that are public, directed or personal to the system (global) by the owner (vMe) or visitors;
- annotations can be created at a system level (out of context) to allow generic comments;
- annotations can be added to a snippet, and *should* be in context;

- annotations can be added to an existing annotation (a thread);
- by creating a wiki from a snippet, a user can modify a copy of a snippet;
- annotations can be added to a multimedia object; and
- annotations are created in date-time order, which is functionally similar to blogging.

Global comments can serve as a bulletin board, enabling the owner of the system to communicate notices that would be of interest to all users.

System annotations are generally considered out of context annotations as they are not attached to any specific content. They can be:

- public where they are meant for all users (e.g. to notify visitors of an upcoming event);
- directed where a specific user or user group is specified; or
- personal (although these could be viewed by the owner of the virtualMe).

The capability to reply to the annotation is also important, for example, if a question is posed in the annotation it would be useful to provide an answer that is attached to the actual annotation.

Similarly annotations can be added to a snippet, and in this case the annotation would *usually* be added in context, though users could choose to add unrelated comments.

Many content management systems rely on bulletin boards or email systems to manage annotations, but a drawback of these systems is that the annotation is separated from the content. For example, an email may be sent by a user to indicate that an amendment to the content is required, but in order to make the amendment there is the additional step of locating the page. In the virtualMe framework annotations are attached directly to the snippet thus retaining the correct context for the comment.

A Wiki system provides another useful annotation possibility, where a duplicate copy of the content (snippet) is made, which can then be modified. If the wiki is deemed to be better than the original content, the owner of the virtualMe, can replace the existing content with the wiki.

### 6.2.2.1 Structuring the annotations

Verhaart & Kinshuk (2006b) described the annotation framework on five tiers: global, content (snippet), thread, element object (MMO) and derived. In addition to containing information and knowledge an annotation can be targeted to person or group, for example: at the owner of the virtualMe (vMe), to all users, or from the owner to a specific user. Note that a user to a specific user has been omitted firstly because the virtualMe has been centred on an individual and secondly annotations can be threaded, so discussion between users would take place in the context of a thread.

Figure 6-7 illustrates the annotation framework grid, where the annotation creator and destination are mapped to the structured annotation types.

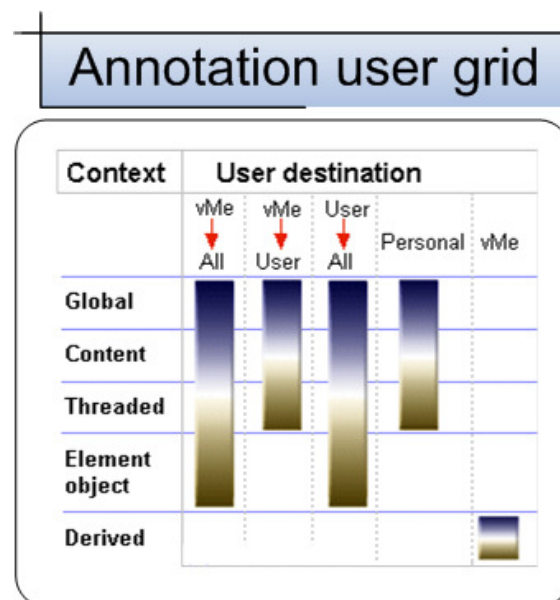


Figure 6-7: Annotation framework grid

*Global* annotations are not attached to a specific content chunk (snippet), for example a message to all. This could be instructions, comments and observations that are for all students, and indeed where a temporal (time based) sequence of global annotations are entered, they would have a similar functionality to a Blog. Using threads users could add annotations to each blog entry thereby maintaining the context.

*Content* annotations, are those that are attached to a particular snippet. A second form of content annotation is also possible. If a duplicate of the content is made this could be amended by the user (wiki technique). The drawback of a fully user updatable wiki, that is where the content can be changed by any user, the accuracy and authenticity is difficult to maintain. For this reason, many wiki systems record changes and allow an administrator to roll back unwanted changes.

*Threaded* annotations are those added to existing annotations. In order to manage the potential of a high cognitive load with multi-threads, each annotation in the virtualMe prototype was restricted to one thread level.

A fragment of an annotation schema relevant to global, content and threaded is illustrated in Table 6-1.

Table 6-1: Annotation schema

Entity	Description
AnnId	Annotation Identifier
UserId	User that created the annotation
TargetUserId	Who the annotation is for
Date	keeps sequence of annotation
Annotation	actual information or knowledge
ThreadAnnId	used if attached to an annotation

Media objects can be attached to each content fragment (snippet). If metadata is attached to this media object, an *element object* annotation is able to be attached. Verhaart and Kinshuk (2006a) describe a prototype of a



self-describing, sharable multimedia object (MMO) and associated media vocabulary markup language (MVML) suitable for managing multiple media data types. Annotations are added to the metadata (MVML) file. Therefore, when a media object is used anywhere in the system the annotation is also available. An example of this annotation type is when an image of a painting is annotated by an art expert.

*Derived* annotations are values accumulated by the system and provide statistical data for a context fragment. For example, footprints/breadcrumbs (or the number of times a particular fragment has been viewed) provide data about the importance of that particular fragment.

A common question asked when discussing this research at conferences has been “how can the annotations of users be quality assured?” A fundamental design decision was to centre the framework on a single individual which is consistent with the notion that knowledge is centred on an individual, rather than a group or organization. In this way, it is believed that users will self moderate. A flaw in an earlier prototype was that the learning domains were separated, and thus the annotations. In this case each domain had to be reviewed to check for added annotations, and in practice this meant they were overlooked. This has been addressed in the current prototype, and all annotations are now integrated. Moderation in the proposed framework would be through the owner of the virtualMe reviewing the annotations and marking any inappropriate comments.

In practice, over the four years that the current prototype has been in operation, no annotations have been of a nature that they needed to be removed due to inappropriate content.

### 6.2.3 Resource acquisition, management and sharing at source

As discussed previously, in order to acquire, manage and share resources a structure that allows this to be explored needs to be designed. The snippet model developed in the earlier prototype (V/2-Online) allowed content to be organized in a structure suitable for teaching and learning, but had a rigid structure, for example, each snippet could only have one image attached. Developing the flexible snippet model and a way to attach multiple digital assets forms an important part of this research.

#### 6.2.3.1 Snippet model

Personal data, information and knowledge need to be capable of being organised in a controlled and consistent way, so this requires that the granularity of each “chunk” be determined. Defining appropriately sized fragments is in the domain of learning objects and research into this area has given some indication for the types of chunks that should be considered. As mentioned earlier a **snippet** or “*a piece of knowledge or information that could be represented by one overhead transparency*”, was a content fragment that proved to be most workable.

In the context of a teaching situation, a piece of content is normally presented to the class as an overhead projection (or as a whiteboard chunk), and is supported by lecture notes. These fragments can then be organized into a lesson, and a group of lessons form a content domain.

In an electronic sense, an overhead can consist of many media elements (*digital assets*). But there are several other issues associated with digital assets that need to be considered. For example, an image displayed on a computer screen (at 75 dots per inch or dpi) produces poor quality results when produced in hardcopy (600 dpi and above). If accessibility issues are considered, then the ability to represent a digital asset in multiple forms is

desirable. For example, an image needs to be described in text, or alternatively in a sound file, to assist screen readers or for those visitors with sight impairment. Finally, if the digital asset is to maintain its original context and ownership, metadata needs to be attached to it.

In order for a snippet to satisfy the requirements of the virtualMe and the teaching context, features that emerged as desirable from the previous prototypes included:

1. attaching metadata such as: a mandatory title, a selection of dates (e.g., creation, flag, and deletion);
2. the capability to be displayed in notes view (A4 or letter size) or presentation view (800 x 600 or 1024x768);
3. being able to contain textual content for both a description (for the printed material) and a summary (for the overhead);
4. being able to be aggregated to enable efficient printing;
5. to have multiple media objects attached, including unstructured media elements (text, image, animation, sound or video) or structured elements (e.g., PowerPoint slide set, Portable Document Format file (PDF), Flash movie, and customized software);
6. having multiple references attached as content is usually based on references that should be cited;
7. the ability to be annotated;
8. being able to be attached to multiple taxonomies;
9. the ability to be represented as a learning object package to allow the snippet to be exported and imported to other virtualMes and to other learning management systems.

### 6.2.3.2 Multimedia object (MMO) model and digital asset

Being able to manage digital assets is an important part of a knowledge management system. A many-to-many relationship should be possible between digital assets and snippets, that is, a snippet should be able to have many digital assets attached, and a digital asset should be usable by many snippets. The capability for a digital asset to be used by multiple snippets, creates interesting contextualisation issues. The following discussion is based on the book chapter: “*Assisting cognitive recall and contextual reuse by creating a self-describing, sharable multimedia object*”, by Verhaart and Kinshuk (2006a).


Image	Text
	Maraetotara falls, a popular swimming spot in Hawke's' Bay, on the road between Havelock North and Ocean Beach.

Figure 6-8: A waterfall

If we look at an image of a waterfall (Figure 6-8), and separate it from the attached text, it will lose context. So, investigation into connecting context information through metadata has been a significant part of this research. For the image example, metadata able to create captioning information, a descriptive tool-tip, or referencing information is useful for a Web page.

In the previous prototype (V/2-Online), as the snippet library grew there evolved a need for a better way of organizing and retrieving attached objects. Images that were suitable for screen display when printed had poor quality, so two images were created, and the appropriate image was used relative to the context.

This concept evolved into a need to describe a wide variety of multimedia objects in a consistent way that allowed for the multiple output requirements. Hence a model that would allow multiple representations of the same media object was developed.

Verhaart, Jamieson and Kinshuk (2004) described the design of a multimedia object (MMO) and its relationship to a snippet, and this is summarized as follows.

Each snippet encapsulates a small useful chunk of data, information or knowledge, and associated with a snippet can be one or more media objects. For example, a discussion on a building may have a picture of the building, a short video clip or some architectural plans. Another example could be a snippet with one or more references, such as a published article in a newspaper, or journal. The formats of the media objects can vary widely. For example, in the case of textual objects they may be formatted in Microsoft Word, Open Office's OASIS OpenDocument (ODT), Adobe's Portable Document Format (PDF), Hypertext Markup Language (HTML), extensible markup language (XML), or LaTeX.

In learning object packages, a manifest file is attached to the component parts. Indeed "the manifest file is considered as the soul of the content package because it keeps information about the learning objects that are in the package (a course folder) and information about how the LOs are organized to provide a learning sequence" (Santally, Govinda, & Senteni, 2004).

In the case of multimedia object (MMO) a manifest file is created using an XML format containing a list of the associated files and metadata containing relevant data about the MMO. In the case of a reference the manifest file would contain sufficient data to be able to produce citation information.

For other multimedia objects, it is desirable to capture other metadata, for example, for an image, its description and rights information would be useful. Unstructured files (such as, images, sounds, animations or videos), or structured files (such as PowerPoint, Flash, and so forth), have a range of metadata that would be useful.

### 6.2.3.2.1 Computer and user view of the MMO

An electronic file has properties that can be derived from the system and include: filename, file size, for an image or video width and height, for a sound or video its duration, as illustrated in Figure 6-9 (Verhaart & Kinshuk, 2006a, p.53).

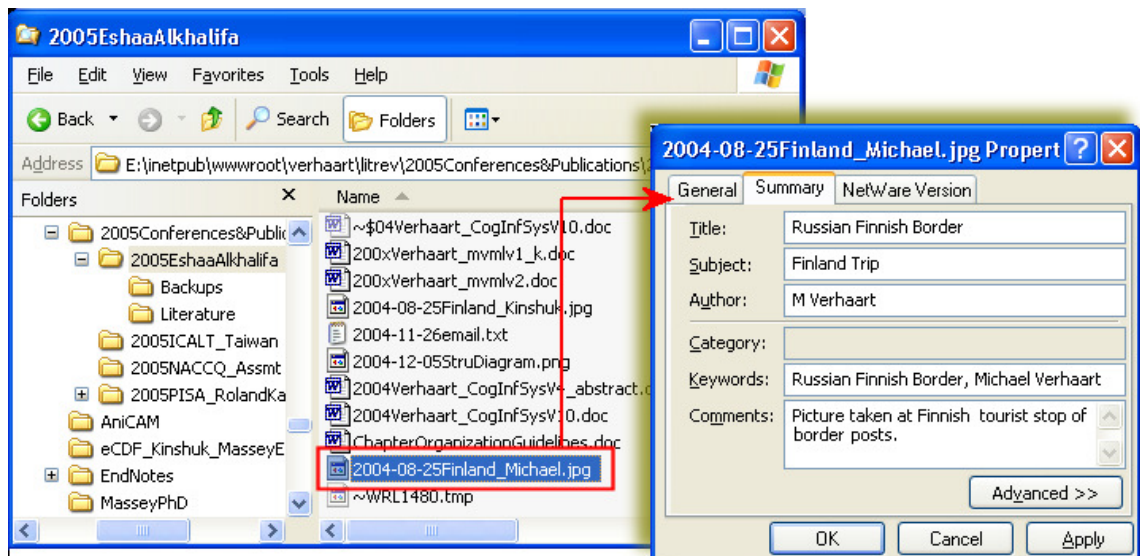


Figure 6-9: jpg file meta-data

Extracting this data requires specialised software utilising operating system calls and unfortunately this metadata is not stored in a consistent way for each file type. In a system that utilizes Internet technologies it can be useful to display this information, for example, in the case of a video, its length and file size can be useful for users with a slow connection in determining whether the video should be downloaded. When creating the MMO metadata, software can be written to extract much of this derived metadata.

Goldfarb and Prescod (2002) identified annotated data as a second type of metadata that is useful to attach to a digital asset. Verhaart and Kinshuk (2006a, p.60) list the following metadata attributes for an MMO: title, creator, subject (keywords), rights, and context. The context is important as it is a textual description of the media element that would describe the element in a way suitable for a blind person. This increases the media element's usefulness as this description is searchable no matter what the element type is.

From a human user perspective, derived content and creator type metadata of an MMO is not enough to successfully describe it, and indeed provides little if any information about actual content or context of the object. This is where the actual context and the 'scene' depicted within the MMO becomes important. The "scene" is what is happening or what is depicted by the MMO.

Consider Figure 6-10, where there are two images of a glass of water situated on a table. A typical description of the image would be "glass of water". The context of the scene describes more in depth knowledge about the scene. The "glass of water" scene context could contain the type of glass, type of table, time of day, season, lighting, just to name a few. A vocabulary is required to describe this scene in such a way that it is understandable by the computer.



Figure 6-10: Two images of "a glass of water"

### **6.2.3.2.2    *Referencing and citation information***

Referencing and citation information is a problem that is commonly encountered when documents are sourced from the internet. Constructing a reference in a recognized format, such as one for the American Psychological Association (APA, 2008) or Harvard often requires a considerable amount of effort. Some publications, particularly digital libraries (ACM, 2008), and in some cases journals or bulletins (NACCQ, 2008) provide a means to extract this data in a controlled and consistent fashion. Multiple referencing styles exist, for example, EndNote (2008), a commercial add-in product for Microsoft Word, has provision for more than 2,000 individual bibliographic styles.

Zotero (n.d.), an open source plug-in to Firefox, or RefWorks (2008), a commercial plug-in for Internet Explorer, can generate citation information for a web page automatically.

### **6.2.3.2.3    *Multiple forms of electronic artefacts***

Resources can exist in a variety of forms, and include implicit or physical elements (such as books, people, and objects), electronic objects (such as, multimedia (text, images, animation, sound and video) and collections (learning objects, presentation objects e.g. PowerPoint slides).

Implicit resources require human annotated knowledge and in most cases do not have derived knowledge metadata, whereas electronic resources have many common metadata attributes and media dependant properties.

Various standards exist that describe how the MMO's should look like and relative behaviour when manipulated or used by software. These standards allow for software interoperability and MMO interchange.

For example, one common Internet standard is the Multipurpose Internet Mail Extensions (MIME) standard (<http://www.iana.org>). This standard



uses the filename extension to determine how software will behave. Typical mime definitions are:

image/jpeg	jpg jpeg jpe
image/gif	gif
application/octet-stream	bin exe com class

### **6.2.3.2.4 Multiple representations**

In trialling the V/2-Online prototype, it became evident that the ability to represent a media element in many forms is desirable. For example, when the first frame of a video is displayed on a web page, this may give little – if any – information regarding the actual content of the video, such as in the case of a video of a bike race, where the first few frames may be of an empty road! So in this case two representations would be desirable, the video itself, and a representative frame as an image showing a bike race.

In the case of displaying a digital photo, it is useful to provide two image files, one for the screen display and one for the high quality hardcopy output. Verhaart (2006) described two 3 Mega-pixel jpg photos (2032 x 1354) with file sizes of 196KB and 1,175KB respectively. Reducing these to screen display size (width 595 pixels), gave 46KB and 157KB respectively, a saving between 4 and 7 times.

Multiple representations could enhance the usefulness of an electronic business card. For example, the information related to the business card could include: a text version of the card, a photo, a curriculum vitae, a video introducing the person, a business card in a different language, and a voice clip with the pronunciation.


The concept of multiple representations of a digital asset is not new, for example, many applications use an icon or thumbnail as a representation of a larger image. Electronic systems can do this in almost real time. For example, browsers render large images into smaller images depending on

the screen size settings or html tag settings. Other systems convert text to speech, speech to text or images to text (optical character readers). Blog sites (e.g. <http://www.blogger.com>) resize uploaded images to prevent users from having very large images.

However this research introduces the concept of a digital asset package (an MMO), where the digital asset is a package containing a structured metadata file, with multiple digital files, to enable contextual data to be captured. Web sites such as Wired News ([www.wired.com](http://www.wired.com)), use this concept where an image of a person is linked to their profile.

The ability to retain the original file type and format was considered to be an important part of the MMO. While other file formats such as MPEG and MHTML (Multipurpose Internet Mail Extension HTML) have the images transformed and embedded within the file, it was considered a desirable feature to maintain the originality of the files.

Researching existing packaging specifications, particularly in the learning object implementations such as CanCore (2006) or UK-LOM Core (Barker, 2006; Campbell, et al., 2004), the files stored in the manifest are renamed and often take the form filexxx. Unfortunately, this creates an issue when the element is separated from the learning object. A solution to this problem was to create a file name for the MMO, and then store all of the files with the same name and include a caret (^) suffix. For example, An MMO package, called aboutMe.mmo, could have media files aboutMe.jpg, aboutMe^icon.gif, aboutMe^CV.htm, and so on. Hence, if the file aboutMe^CV.htm was separated from the MMO a web search for aboutMe.mmo could find and retrieve the original MMO. An example of this is shown in Figure 6-11.



Name ▲	Size	Dimensions	Type	Date Modified
2004Verhaart_FinlandRoad.mvml	2 KB		MVML File	18/10/2004
2004Verhaart_FinlandRoad.doc	20 KB		Microsoft Word Doc...	29/11/2004
2004Verhaart_FinlandRoad.jpg	452 KB	1656 x 1242	Paint Shop Pro 5 Im...	5/09/2004
2004Verhaart_FinlandRoad.mid	22 KB		vanBasco's Karaoke...	19/08/2001
2004Verhaart_FinlandRoad.mp3	2,293 KB		MP3 audio file (mp3)	25/04/2003
2004Verhaart_FinlandRoad.ppt	8 KB		Microsoft PowerPoi...	29/11/2004
2004Verhaart_FinlandRoad.wav	55 KB		Wave Sound	19/08/2001
2004Verhaart_FinlandRoad.wmv	530 KB	800 x 600	Windows Media Aud...	20/02/2003
2004Verhaart_FinlandRoad^.jpg	3 KB	94 x 70	Paint Shop Pro 5 Im...	24/11/2004
2004Verhaart_FinlandRoad^w295.jpg	17 KB	295 x 221	Paint Shop Pro 5 Im...	25/11/2004
2004Verhaart_FinlandRoad^w595.jpg	47 KB	595 x 446	Paint Shop Pro 5 Im...	25/11/2004

Figure 6-11: MVML file manifest

There are many package formats that are being used on the Internet. These include: widgets (Mozilla Firefox) and gadgets (Windows Vista), Microsoft's Office 2007 and the OOXML file formats (e.g. docx), and the Open Office Open document format (ODF). In almost all of these cases they are actually a zip archive file with unique file extensions.

As mentioned in Chapter 3 (3.3.2.1) a significant problem facing a content developer is the wide array of media types, competing standards and a necessity to add new components and plug-ins to take advantage of them.

Rights information is a complex issue on the Internet, and the issue is far from being sorted. For example, Google (2007) wants to scan copies of books in libraries to create a massive digital library and is facing litigation from many publishers (Jordan, 2007). Wikipedia (2008a) uses a tagging system for images to manage the various categories of copyright, which include GNU Free Documentation License, Creative Commons, Public Domain, and No rights reserved. In Wikipedia's case the goal is to have a public encyclopaedia so that all work submitted is covered by the "GNU Free

Documentation License" (Wikipedia, 2002). Copyright, fair use, and structures such as Creative commons, (<http://creativecommons.org/>) make this area very difficult to structure. In many cases, particularly in the area of learning objects, the standards are very vague, leaving the implementation up to the individual application developers. In Dublin Core, specific elements include Rights, Provenance (ownership change statement), and RightsHolder (Hillman, 2005b), but these are free format unstructured text entries. As this is a small component of the MMO, rights information is catered for, but left as a future enhancement.

#### **6.2.3.2.5    *The MMO System interface***

To be usable, an MMO is required to have a standard and structured vocabulary, and to accommodate this, the Media Vocabulary Markup Language (MVML) was developed. It provides a schema that can be used to organise the metadata in a common and consistent way, and can be used to allow standard interfaces to be developed to allow for the sharing of objects, either by maintaining a link to a repository or maintaining a “personal” repository. Textual or graphical interfaces such as “Kartoo” (<http://www.kartoo.com>) could be built utilizing the MVML metadata, and could also be easily transformed into a variety of alternative interfaces (such as an audio based interface).

From a **human** perspective, MVML repositories allow for Boolean or Natural Language Processing (NLP) searching based on keywords or context, and the construction of context specific resources in a structured and consistent format.

From a **computer** perspective, an index of MVML repositories could be maintained. These could be searched by many devices, including mobile (electronic) agents where a criterion is specified.

The MMO could produce the data using the MVML metadata for the appropriate device, such as PDA, or PC screen. The output would be adapted to the appropriate user interface.

#### **6.2.3.2.6    *Metadata standards***

As discussed in the literature review, any proposed metadata structure should be consistent with existing standards. Those included in the MMO/MVML specification are: Dublin Core; xCard, and EndNote.

One critical feature that appears to be missing in metadata schemas is the ability to re-aggregate if an element becomes separated. The naming convention proposed in the MVML/MMO allows re-aggregation, as the name itself provides sufficient information to search for the mvml file if it exists. This is an important component that allows a digital asset to be shared while enabling re-linking of the contextual data should individual elements become separated.

#### **6.2.3.2.7    *MMO desirable features***

Based on prototypes developed and trialled, desirable features for multimedia objects (MMOs) include:

1.     the capability for the metadata to produce a standard reference (e.g. APA);
2.     the capability for the metadata to generate an electronic business card for the author(s);
3.     the MMO metadata contains sufficient data for each object to assist in web page construction (e.g. for an image, height, width, alt tag representation);
4.     the metadata contains original context information (suitable to describe to a blind person, this will also facilitate text searching of all media objects);

5. the capability to manage a wide variety of media types (including legacy);
6. the capability to manage multiple representations of a digital asset;
7. the metadata to contain rights information;
8. the metadata can be used to generate other digital asset metadata; and
9. the capability of components to be reconnected to the metadata should they become separated.

Table 6-2 gives a comparison of different metadata standards and how well they meet these critical features.

Table 6-2: A comparison of MMO Critical features and existing digital asset meta data standards

Critical feature	Dublin Core	vCard /xCard	EndNote	MPEG-21	METS	PRISM	RAMLET
1. Metadata will be able to produce standard reference	N	N	Y	?	?		?
2. Can produce an accurate representation of business card for the author(s)	N	Y	N	N	?		?
3. For each object in the MMO contains metadata suitable for display in a web browser	N	N	N	N	?		?
4. Each MMO contains original context information	Y	N	N	Y?	?		?
5. Can represent all media types (including legacy)	N	N	N	Y?	?		Y
6. manage multiple representations of a digital asset.	N	N	N	Y?	?		Y
7. Contains rights information. (*Dublin core = qualified)	Y*	N	N	Y	?		?
8. Is usable by other Digital Asset Metadata standards	Y	Y	Y	N	?		Y
9. A component can be reconnected to the metadata should it become separated	N	N	N	N	N	N	N

Where Y = Yes, N = No, and ? = could not be determined or not clear.

#### **6.2.3.2.8    *Media Vocabulary Markup Language (MVML)***

In order to describe the contextual information of a media object the metadata can be managed in a schema described in extensible markup language (XML). In the context of this research, it is desirable that it conforms as closely as possible to existing standards. In this way similarities are easily identified, and differences are highlighted.

As the schema in this research is continually evolving, and as many of the standards being considered are also continually being revised and updated, an environment that allows for rapid change is necessary.

As discussed in the literature review, Extensible Markup Language (XML) has become standard way to represent data structures on the Internet. Furthermore, XML incorporates other technologies that would be useful in the development of the MMO/MVML. Once the metadata is described in XML, XSLT (extensible Stylesheet Language Transformation) can be used to transform the MVML XML to a variety of other formats such as Dublin Core, vCard, Endnote, and to produce a reference in a desired style such as APA.

The XML structure can be described using Document Type Definitions (DTDs) although XML Schema is more desirable (Phillips, 2000, p 147, Goldfarb & Prescod, 2002). While both DTDs and XML Schemas provide a way to describe the structure of the XML file, they do not provide a generalized way to create a template, that could be used to create an input form to allow a user to enter the metadata. In order to allow this the media vocabulary markup language (MVML) was created.

#### **6.2.3.3        *MMO/MVML Architecture***

In order to compare several different metadata structures (such as, Dublin Core, vCard and EndNote), the initial prototype MMO/MVML includes all the elements with assigned namespaces. A future plan is to normalize the

data structures within the MMO/MVML model with the intention that XSLTs will be used to transform the MVML to the desired structure.

Figure 6-12 shows that the MVML definition template is combined with the media files and a template is generated to allow a user to input the metadata. This metadata and the media are combined to form the MMO. Using XSL transformations the metadata can be transformed into various formats. When the MMO (with MVML file) are used by an application, data such as title can be extracted and the appropriate media element can be selected for the display device.

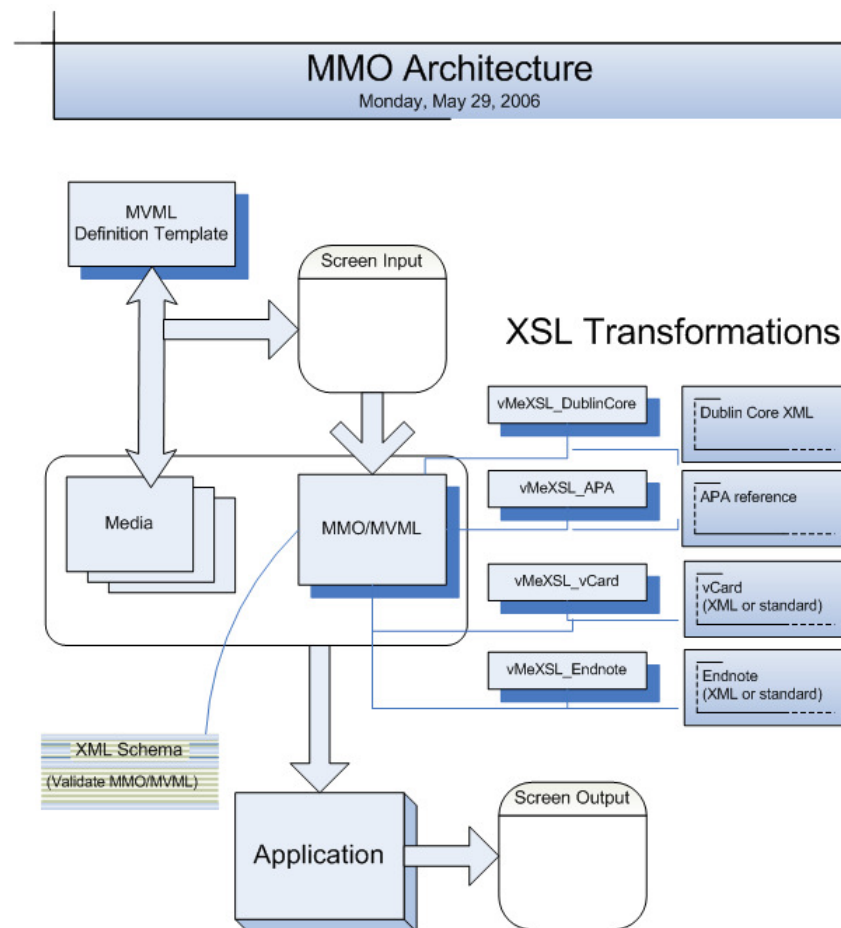


Figure 6-12: MMO/MVML architecture



### 6.2.4 Teaching and Learning

The original design goals for V/2-Online were that:

- content must be displayable on an Overhead Projector (OHP), and
- content must have an equivalent hard copy version.

In order to conform to the research findings, the virtualMe prototype was based on a *snippet*, (content represented by one overhead transparency), and to be designed to also assist in face-to-face delivery. Figure 6-2 also illustrates the important components of the framework in relation to a teaching and learning environment.

Developing a lecture requires preparing the content (may be from a text book or personal notes) and creating the presentation (often PowerPoint or similar). There are advantages in providing an ability to display content as printable notes or as a presentation, particularly in avoiding duplication and managing changes in two places.

A snippet is not an isolated learning object, and as such requires a taxonomy to provide context. A “backbone taxonomy” (Guarino & Welty, 2002) is used to manage the sequencing and linking of the snippets, and operates in a similar fashion to a book index. An issue that has been resolved by the database snippet version was that of printing lecture notes. In previous prototypes, students were required to select each page in turn and print out separate pages. This was both a time consuming exercise and created a lot of pages often with very little content. The database solution allowed multiple snippets to be presented as a continuous page.

Text is not the only medium used to deliver teaching material though it has many advantages over other media, and in many cases it contributes significantly to the presentation in a multimedia rich environment. Standard HTML caters for a multimedia rich environment by linking to external media elements.

As lectures are often constructed by using resources from many sources, referencing those resources correctly is important. The ability to manage references and cite correctly has been an important part of the proposed framework.

Using the database approach also enables users to add annotations. The ability to add comments in a structured way allows users to interact with the content and thereby with the lecturer and other students.

There are many ways in which various teaching and learning strategies can be incorporated into the framework, for example:

- users movements through the system can be tracked providing the capability for students to see what they have visited (breadcrumbs);
- where users have been (footprints) can be tracked;
- student participation and collaboration (constructivist) can be fostered via annotations; and
- scaffolding can be implemented in a blended environment by revealing snippets incrementally.

## **6.2.5 Conclusion**

This chapter presented the background design of the virtualMe framework, particularly with regards to the annotation framework and the multimedia object model.

The following chapters discuss the implementation of the virtualMe prototype developed to support and validate the design, and analysis. Firstly, the overall implementation including the user interface, taxonomy and snippet model is discussed. This is then followed with a chapter that looks at the implementation of the multimedia object model.

## 7 Action research cycle three: The virtualMe implementation

Based on the previous action research cycles, the virtualMe framework which incorporates an annotation framework, and a multimedia object (MMO) model was developed. The features identified were then implemented in the virtualMe prototype. Using the prototype the virtualMe framework has been validated through: demonstrating the feasibility of the framework; reviewing data collected by tracking user movements in the prototype; and soliciting feedback from actual and potential users.

The virtualMe prototype was based on the snippet concept that evolved from earlier research. Figure 7-1 displays an overview and shows how in the virtualMe prototype, the “*Example of a gif animation*” snippet, is displayed in both page and presentation (OHT) view, and how this snippet is incorporated in a multimedia domain taxonomy.

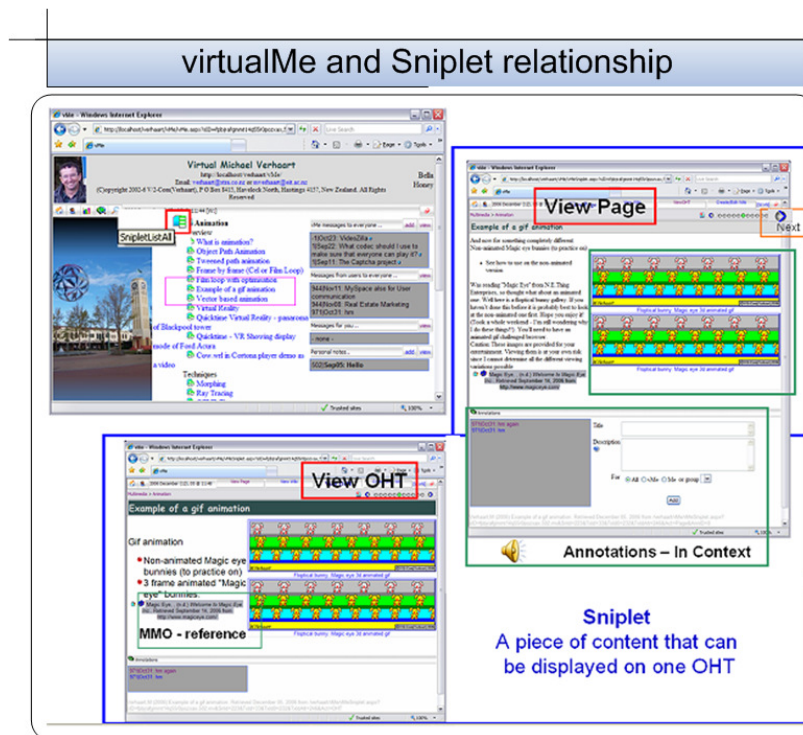


Figure 7-1: virtualMe screenshots showing multiple snippet views, the taxonomy and annotations

The **virtualMe** is essentially a personal knowledge management framework that is centred on an individual and assists in collecting, managing and sharing their personal knowledge.

How then was the virtualMe framework implemented by a computer system? This chapter discusses the implementation of the virtualMe framework, and the following two chapters look at two parts of the framework: the annotation framework and the multimedia object (MMO) model. Appendix C provides a walkthrough of the prototype from a user's perspective.

### **7.1.1 Implementing the virtualMe architecture**

In the previous chapter, a logical model view of the virtualMe framework was discussed (Figure 7-4), which contained five layers: the snippet layer for storing the content, the taxonomy layer to organize and structure the content, the system layer to manage the physical organization of the database, the user layer to manage user profiles and preferences, and an annotation layer to manage comments and notes from users and visitors to the system.

#### **7.1.1.1 Snippet Layer**

In order to deliver content in a coherent way it was necessary to define the smallest chunk that could be used, and in the virtualMe the core of the model is the content (information and knowledge) itself, and is represented by the "**Snippet**":

*"a piece of knowledge or information that could be represented by one overhead transparency"* (Verhaart & Kinshuk, 2003, p. 153).

An example of a snippet in a multimedia course and how it is created/edited is displayed in Figure 7-2.

The snippet can be displayed in a variety of ways: page view, OHT view (see also Figure 7-1), or wiki view. Although the wiki capability was implemented, it was not used by any of the prototype's users. As shown by the edit view, each snippet is a record in a database table and contains a title, the content for the page view and overhead view, and links to the attached digital assets (multimedia objects).

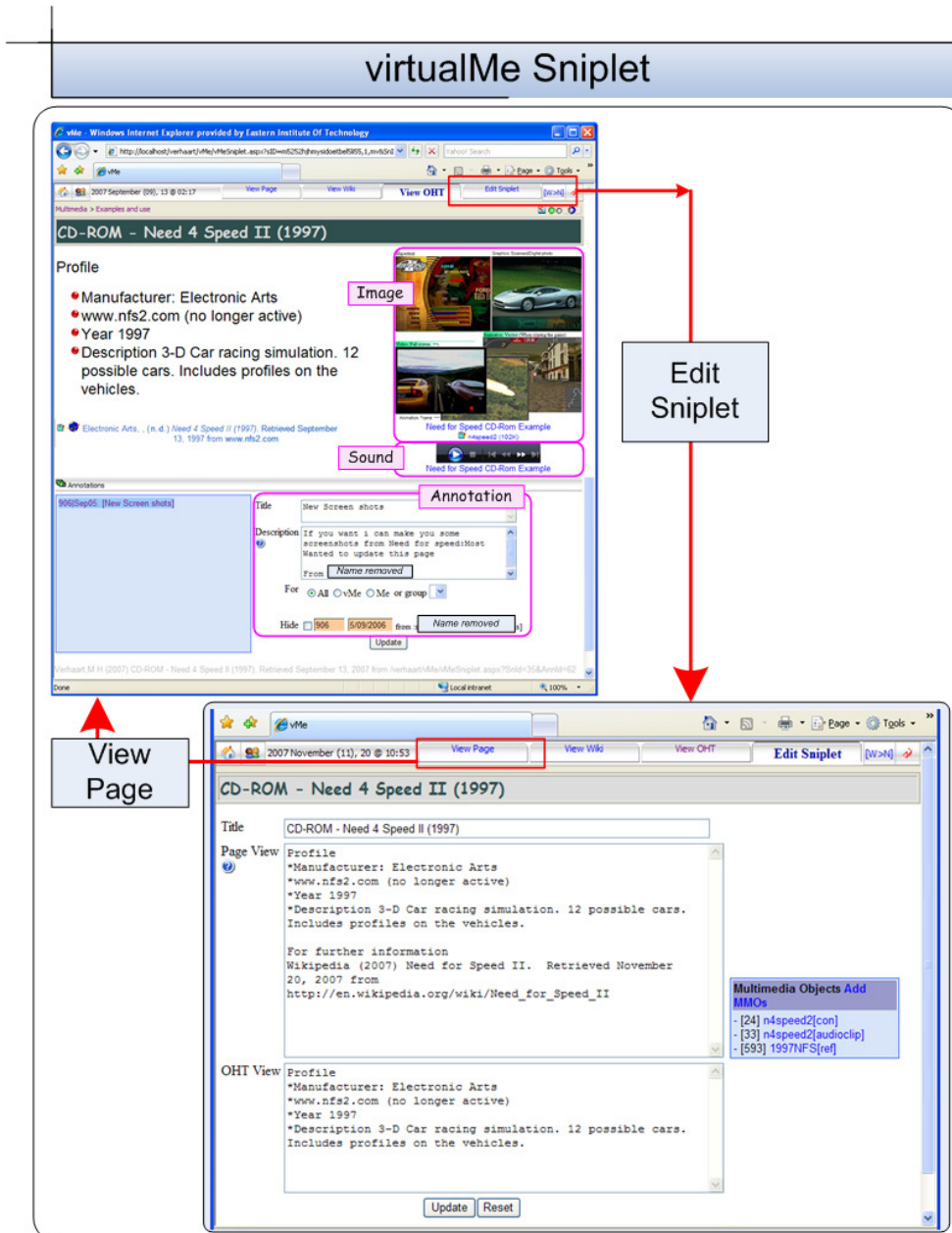


Figure 7-2: Sample of a snippet prototype showing attachments including an image, a sound and an annotation, and how a snippet is created and edited.

The title "CD-ROM - Need 4 Speed II (1997)" is an example of the snippet metadata, and the textual information gives a brief profile of the game. Digital assets include the collage of screen captures, a sample sound file and a link to the associated web site.

One important feature identified by earlier prototypes was the ability to combine snippets sequentially to avoid having to printout each snippet on its own. Figure 7-3 illustrates combining snippets based on the taxonomy, and this particular example shows a wide variety of digital asset types: audio showing the media player, an image (screen shot of windows sound recorder), and a small video player image that links to a new window to run media player.

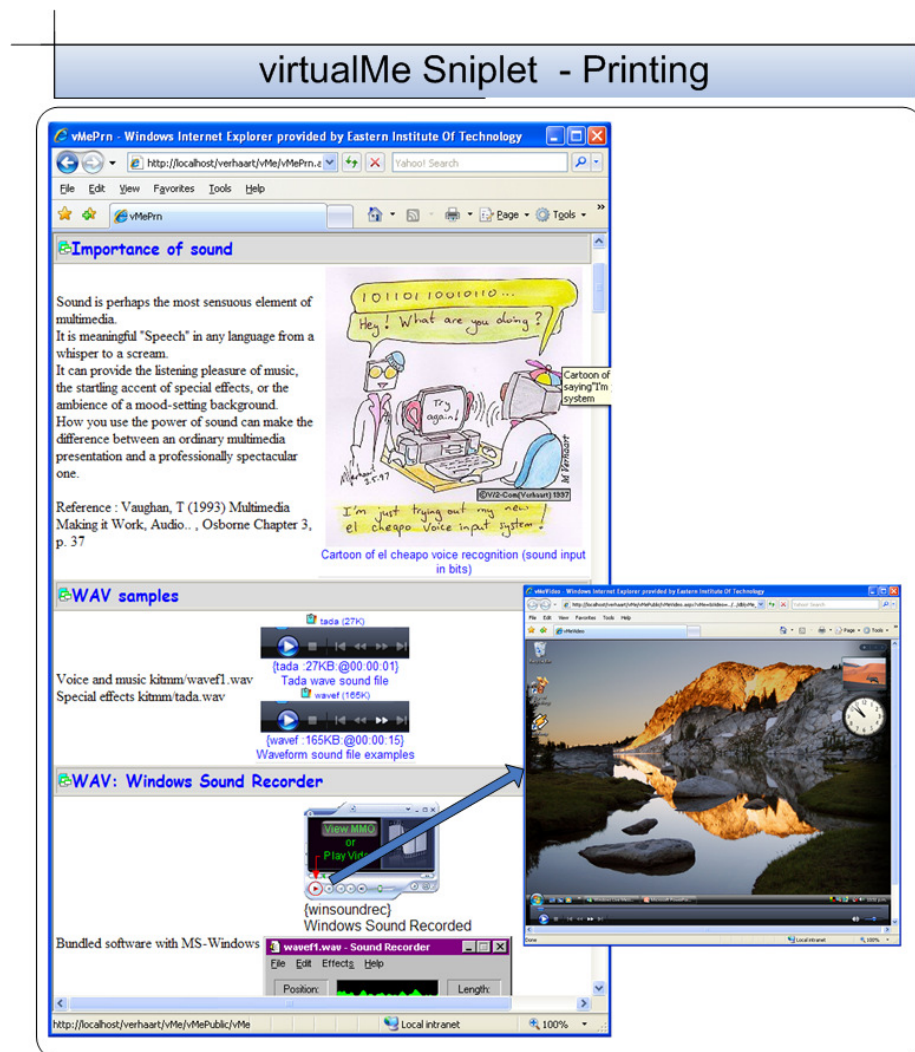


Figure 7-3: Snippets can be aggregated for printing.

Developing the user interface for the snippet presented many challenges, for example, issues arose when trying to access media elements outside of the researcher's institution's firewall, as some elements (e.g. videos) were blocked. Some students used Firefox as their preferred Web browser and this too created issues, for example, on an image both alt and title tags were required to display a tooltip, and videos would display as thumbnails unless the height and width tags were used. However, this vindicated the original decision to put the size of the object as metadata in the MMO.

### **7.1.1.2 Taxonomy Layer**

Above the snippet layer is the taxonomy layer providing structure and context to the snippets. From the structural perspective, there are two taxonomy views: the "backbone taxonomy" (Guarino & Welty, 2002), and using a portion of a taxonomy in a different domain. From the teaching perspective, the virtualMe is arranged into teaching domains, such as, multimedia, database, Web design and so on, rather than in a teaching lesson format popular with many learning management systems. This is illustrated by the topic list shown in Figure 7-4.

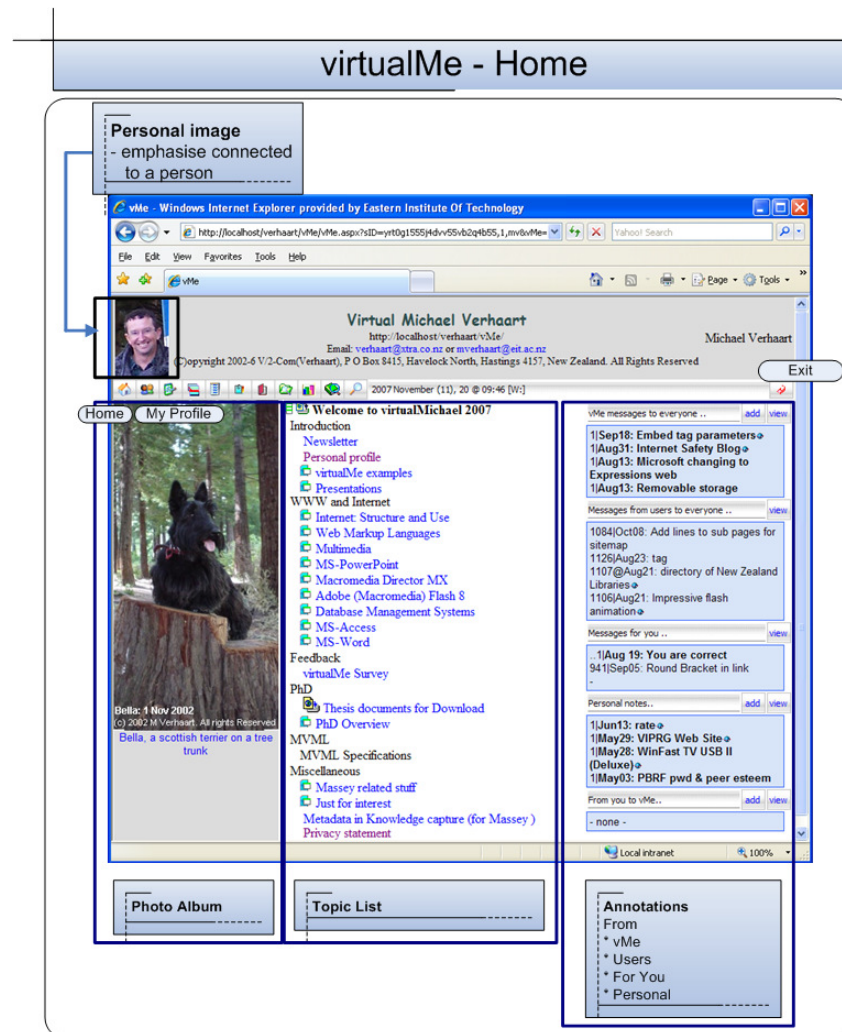


Figure 7-4: virtualMe – individual's homepage

During a discussion forum in which the earlier prototype V/2-Online was presented, a question was asked if the system could reuse parts of the taxonomy, for example, if a topic on image resizing was created in the multimedia domain, could this be reused in the Internet and Web design or database domains. This is similar to a desktop shortcut in Microsoft Windows, and was implemented in the virtualMe prototype, although this did increase the level of complexity in creating the backbone taxonomy.

The virtualMe prototype uses a tree structure, allowing each snippet to be assigned to a backbone taxonomy and to exist in alternative taxonomies. An example of partial backbone taxonomy that could be used in a lecturing scenario in the Internet domain is shown in Figure 7-5.



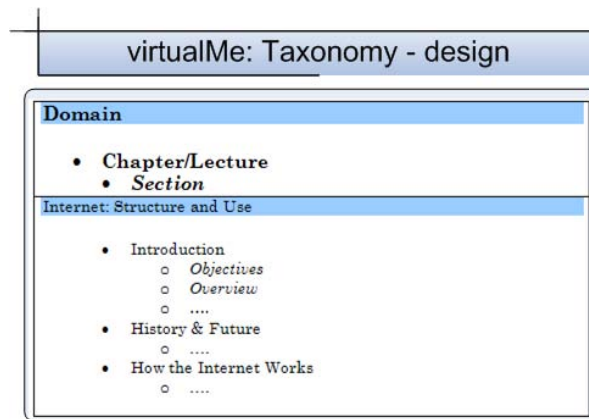


Figure 7-5: Example of partial backbone taxonomy of domain of Internet

Figure 7-6 shows web forms that allow the taxonomy to be managed. The top form shows the “*Internet Structure and Use*” entry allowing update. With the sub-list box checked, this links to the lower form displaying the attached sub-list. Note the tree structure is composed of headings and sub-headings, and snippets will be attached to them.

**virtualMe: Taxonomy - administrator view**

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ID	Order	Index	Sub	Title	HTML	New	Access	URL
24	10	0	1	Welcome to virtualMichael 2007				
14	20	1	1	Introduction				
15	30	2	1	Newsletter				<a href="#">ldnMe_mvnewsletter.html</a>
23	40	2	1	Personal profile				<a href="#">ldnMe_mvbuscard/Verhaart_M.htm</a>
136	100	2	1	virtualMe examples				
135	110	2	1	Learning Domains				
135	110	2	1	Ethics and Professionalism			ADMIN	
681	191	1	1	WWW and Internet				
202	2	2	2	Internet: Structure and Use				
1730	2	2	2	Web Markup Languages				
7	2280	2	1	Multimedia				
666	3260	2	1	MS-PowerPoint				
2	3260	2	1	Macromedia Director MX				
3	3820	2	1	Adobe (Macromedia) Flash 8				
5	4060	2	1	Database Management Systems				
1	4800	2	1	MS-Access				
621	5290	2	1	MS-SQL Server			ADMIN	
197	5330	1	1	Feedback				
649	5340	2	1	virtualMe Survey	Y			<a href="http://www.virtualMV.com/MvEvaluation/Default.aspx">http://www.virtualMV.com/MvEvaluation/Default.aspx</a>
18	5350	2	1	Guest book	Y		ADMIN	<a href="http://is.research.massey.ac.nz/verhaart/guestbook.asp">http://is.research.massey.ac.nz/verhaart/guestbook.asp</a>
19	5360	2	1	Evaluation - 2004			ADMIN	<a href="http://evaluation/default.asp?db=dbeval2004&amp;dm=Snippet">http://evaluation/default.asp?db=dbeval2004&amp;dm=Snippet</a>

**Sub-list**

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ID	Order	Index	Sub	Title	HTML	New	Access	URL
6	200	2	1	Internet: Structure and Use				
67	210	3	1	Structure				
58	220	4	1	Introduction				
59	260	4	1	History and Future				
712	320	4	1	How the Internet works				
313	380	4	1	Searching				
60	460	3	1	Tools				
61	470	4	1	WWW (Hypertext Page Browsers)				
314	550	4	1	Email				
315	670	4	1	User communication				
316	710	4	1	Usenet				
317	790	4	1	FTP				
318	830	4	1	Telnet				
319	860	4	1	Other Tools				
320	910	3	1	Uses				
392	920	4	1	Personal and Household use				
393	940	4	1	eCommerce				
394	1010	4	1	mCommerce				
395	1030	4	1	Public sector uses				
643	1050	4	1	Other				
321	1070	3	1	Design				

Figure 7-6: The taxonomy of the snippet model and sub-list for “Internet structure and use” in administrators view

Features of the taxonomy illustrated in Figure 7-6 are as follows:

- *Order* manages sequence and allows the reorganization of the structure using a numerical ordering.
- *Indent/Lock* enables the structure to be presented as headings and indented sub-headings. The Lock feature allows an option to be hidden if, for example, maintenance is required.
- *Sub-list* allows parts of the taxonomy to be condensed, so that it can be better displayed on screen.
- *Access* allows rights to be managed, in the example the ADMIN rights allow a domain to be developed and tested, while being hidden from users.
- *URL*: allows a menu item to link directly to a URL, such as a "Personal Profile" page, external web sites, and on-line evaluations.

Organising the snippets as an ordered list enables them to be printed out in a continuous page.

### **7.1.1.3 System Layer**

The system layer manages the overall structure and user interface. Unlike the V/2-Online prototype, in the virtualMe, domains were integrated into a single taxonomy layer, as two significant issues were identified: to easily share content between domains, and enable global searching through all the domains.

Allowing users to customize their interface is handled in the system layer, for example, users could choose a colour scheme to display the content, using a selection of cascading style sheets (CSS).

Allowing multimedia to be sourced from alternative places, such as the local hard drive, a CD-ROM or the internet is also managed at the system level. The V/2-Online prototype identified an issue associated with the location of multimedia. The logical place to store the "virtualMe" would be on the Web,

and would include both the HTML pages and the multimedia files. Unfortunately it was found that some corporate firewalls restrict the availability of some media types, such as audio and video, and in more extreme cases images, so the ability to switch where the multimedia could be sourced was important. In the corporate scenario, the multimedia can be stored on a local file server while the HTML files can be accessed from the web site. In a teaching environment, many students may access web sites using slow internet connections, or access that is paid for by the megabyte. In this case, students could be supplied with a CD-ROM containing the multimedia, and reference the web for the HTML files. One drawback of this approach is that as the HTML files are dynamic, the multimedia on the CD-ROM would become outdated or not be synchronized with those on the web server. It should also be noted that this feature is available for Microsoft's Internet Explorer and does not work with many other browsers.

Personal customisation of the "virtualMe" is also a role of the system layer, examples include: a collection of startup images managed at the system level, or a startup message for the home page of the web site that is displayed during the user's logging-in process.

The data that defines the system layer is maintained in the user layer.

### **7.1.1.4 User Layer**

Four user types have been identified:

- the *admin* user, also referred to as the virtualMe (vMe) - on which the content is to be centred;
- *students* - as the prototype was designed as a tool for face-to-face delivery with online support, the students of the virtualMe form the major user group;
- *registered visitors* - as the prototype is Web based, this allows access by a wide variety of users, for example, colleagues with similar

research interests, family members interested in keeping in touch, students from other institutions; and lastly

- *guests* that are people who would like access to the prototype but remain anonymous, or wished to preview the prototype.

The user profile data collected for the virtualMe is similar to those of V/2-Online and included basic demographic, contact and initial preferences data, and this was collected when the user entered the prototype.

#### 7.1.1.4.1 User profile

The Web form to enter a user profile is illustrated in Figure 7-7.

The screenshot shows a web form titled "virtualMe – user profile". The form is organized into several sections: "Login", "Details", "Media", and "NewUser". The "Login" section includes fields for Name (pre-filled with "guest"), Password, and Level (pre-filled with "6"). The "Details" section includes fields for Last Name (pre-filled with "Guest"), First Name (pre-filled with "Guest"), Initials, Country (dropdown), Age (dropdown), Culture (dropdown), Language (dropdown), and Email. The "Media" section includes fields for Local (pre-filled with "E:\inetpub\wwwroot\verhaart"), Web (dropdown), and Network (pre-filled with "EIT(Student), New Zealand"). The "NewUser" section includes a checkbox for "NewUser" and a text area for "Comment" (pre-filled with "Guest login. Joining allows further access.").

Figure 7-7: User profile

Aside from the common fields that include the user's identifier, password, name, email address and so on, the comment field was an important one for the earlier V/2-Online prototype. In the V/2-Online framework it was used as an alternative communication medium allowing one-to-one comments between the user and the person who generated and maintained the content. This is consistent with a physical me where a person communicates directly with the knowledge owner. This was replaced with an annotation capability in the virtualMe prototype.

Both V/2-Online and the virtualMe allowed new users to create their own profiles, facilitating a simpler management of the personal online data capture.

Experience from the actual prototypes demonstrated the need for the password reminder question, as users frequently forgot their passwords. It was found that users choose one of the two solutions to resolve this problem: creating another new profile, or emailing the owner of the prototype to change their password.

In order to provide a level of protection to the individual, a privacy statement (Figure 7-8) was included in both prototypes.

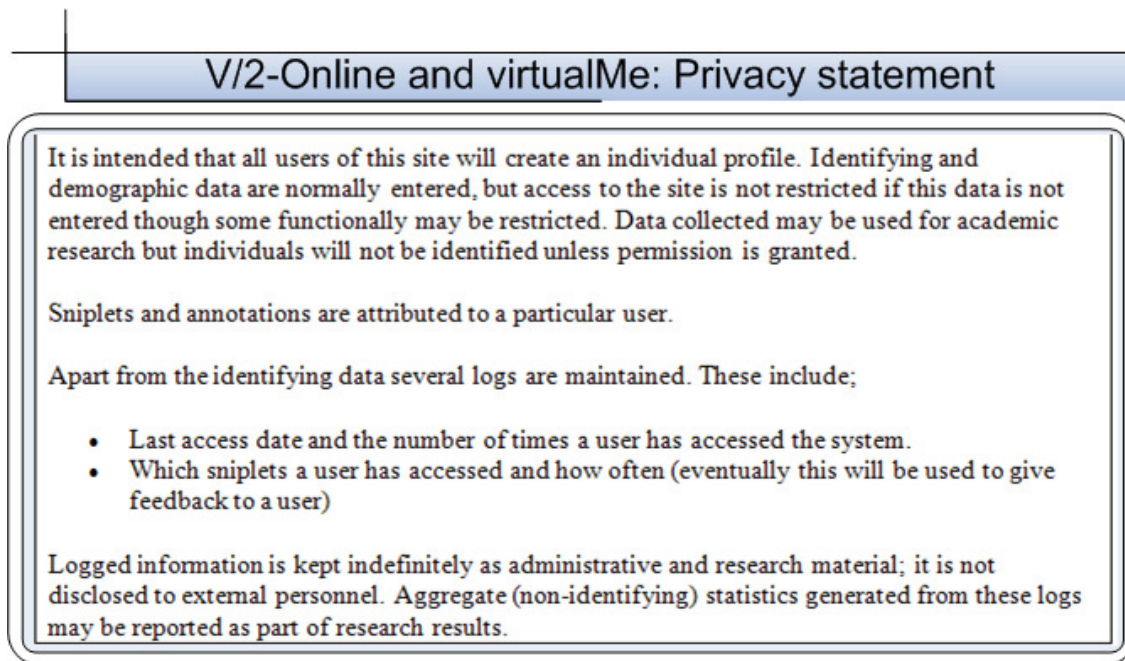


Figure 7-8: V/2-Online and virtualMe privacy statement

As indicated by the privacy statement, the user layer also manages a user activity log where movement within the prototype and frequency of access is monitored.

## 7.1.2 Annotation layer

An annotation was defined earlier as “a comment added to an online system by a visitor”, and can be either in or out of context. In the V/2-Online prototype the domains were separated which meant that each domain had to be opened separately to read the annotations.

In the virtualMe prototype, annotations were consolidated into the annotation framework, and those most recently added could be viewed on the main page of the prototype (Figure 7-4). These were grouped as: vMe messages to everyone, messages from users to everyone, messages to the user, and personal notes. Access to the annotation viewer (Figure 7-9) was by selecting the view button. In this view annotations could be selected using the titles from left hand panel, and filters applied.

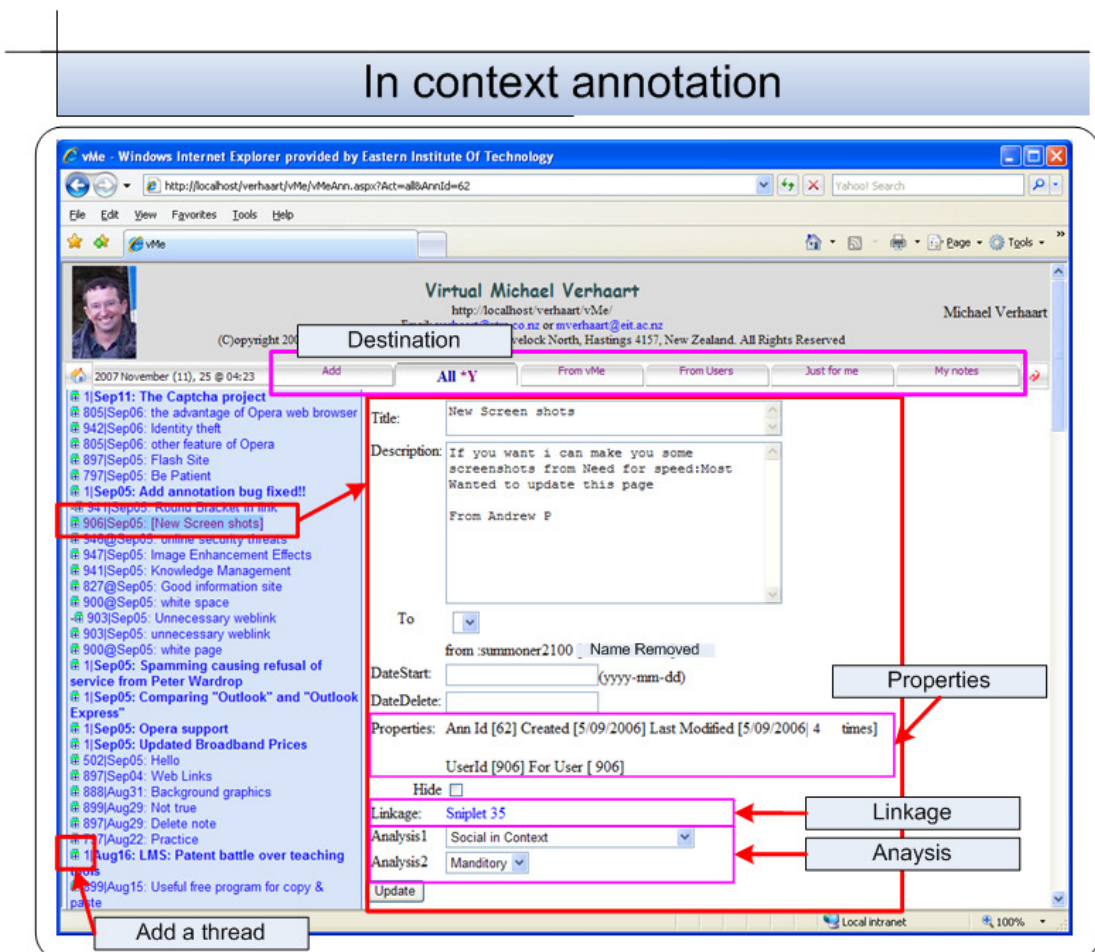


Figure 7-9: virtualMe annotation viewer

Annotations directed to all users but not attached to existing content (*out of context*), can be added by selecting the “Add” tab. These annotations can be directed to everyone (all), to the virtualMe (vMe), to a specific user, and although not implemented in this prototype, to a specific user group. As an example of an out of context annotation, a note to students was added the day after an earthquake was felt, with a link to a site that described its magnitude and position.

Aside from the title and description of the annotation, additional fields found useful included: date when the annotation was to be displayed (DateStart), and date when the annotation would be hidden (DateDelete). This allowed an annotation to be created ahead of time that would appear from a specified date, and to give an annotation a specified date when it would automatically disappear.

An annotation that has been added to a snippet (*in context*), as illustrated in Figure 7-2, can be displayed in the snippet viewer (Figure 7-9). The annotation can be hyperlinked back to the snippet (in the example by clicking on Snippet 35) so that the annotation can be viewed in its correct context. Additional annotation information created or collected by the prototype (labelled Properties) included: the system identifier (AnnId), the date created, when it was last modified, how many times it has been modified, the identifier of the user who created the annotation, and who is the intended recipient.

In order to analyse the annotations, two structured fields were created. The first field recorded the type of annotation and the second whether this annotation was optional (default value) or mandatory. Analysis based on these fields will be described in Chapter 10.

A further requirement was the ability to allow an annotation to “be added to an existing annotation”, commonly referred as “adding a thread”. In the prototype this was implemented by clicking on the icon to the left of the title in the left panel (Figure 7-9).

Earlier prototypes also highlighted a need to allow for the original annotation to be editable by both the virtualMe and the user, so that errors could be corrected, particularly due to the public nature of the annotation. It was also thought that providing this ability would allow for inappropriate comments to be edited out, though interestingly, this was never required.

### **7.1.3 Multimedia object (MMO) layer**

Attached to each snippet is a collection of resources, or *digital assets*, and these can include links to web based resources, multimedia elements or references to physical resources such as books or journals. Figure 7-10 illustrates a snippet on New Zealand Paua displaying an image of a sample Web page. Clicking on the image hyperlinks to the Multimedia Object/Media Vocabulary Markup Language (MMO/MVML) package viewer. From the package viewer a user can view the different media elements making up this digital asset (a navigation map and final page for the web site), and other representations of this asset, including metadata schemas for Dublin Core, vCard, and an APA reference. In the prototype every media element is linked to an MMO collection.



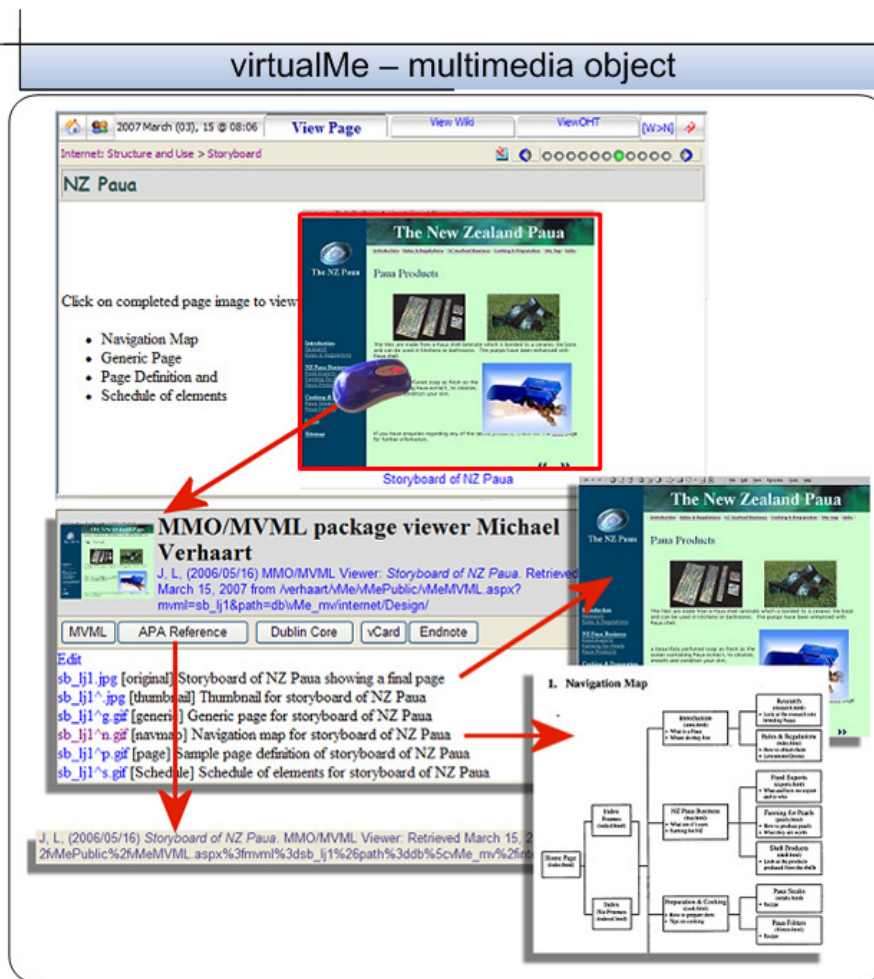


Figure 7-10: Multimedia Object (MMO) of storyboard components

### 7.1.3.1 MMO/MVML File

Each digital asset in the prototype is made up of a collection of files which includes: an MVML file containing the metadata describing the digital asset, and the actual media files. An excerpt of an MVML file attached to an image is illustrated in Figure 7-11.

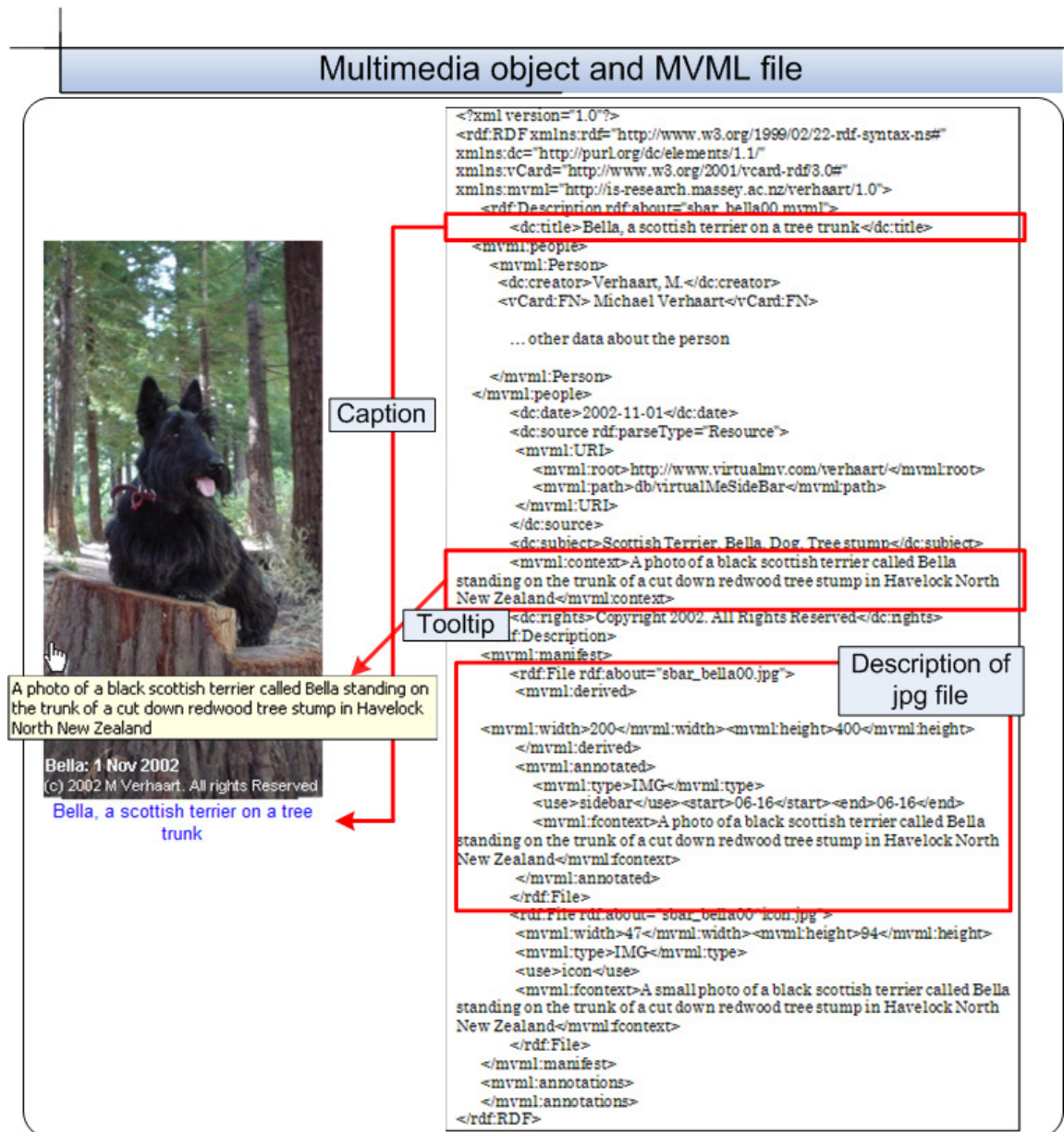


Figure 7-11: Image of Scottish Terrier (Bella), with attached MVML file.

The MMO/MVML combination is discussed in further detail in Chapter 8.

### 7.1.4 Teaching and Learning

In the previous chapter it was stated that there were three important requirements for the prototype in a teaching and learning environment, the ability to: display content on an overhead projector, in a notes view, and in a continuous view suitable for hard copy. Figure 7-1 illustrated the ability to display the snippet on both an overhead projector, and in a notes view, while

Figure 7-3 illustrated how the snippets could be combined into a format suitable for printing.

As text is not the only medium used to deliver teaching material, an important requirement is the ability to handle multimedia. Figure 7-2 illustrated how a snippet could include multimedia elements (image and audio). Figure 7-10 illustrated a snippet that provided students with multiple views of a storyboard exemplar and demonstrated the use of an MMO, where students can “drill-down” on a media element for related content. Both of these examples are suitable in a lecture format.

The prototype was also suitable as a mechanism to deliver a sequential list of instructions, so practical techniques could be presented to students. Using the page view mode, a sequence of instructions can be created to be followed by students, and when combined, can produce a student workbook. With the capability to display the workbook as a series of overheads this can be used when describing the steps to a class group. The ability to attach an MMO to the snippet enables an image that describes the steps to be linked to a video that actually performs the steps, as illustrated in Figure 7-12. One advantage of using video is that the steps can be viewed even if – as would generally be the case – the actual application was not available to the students.

## Snippet showing instructions and related video

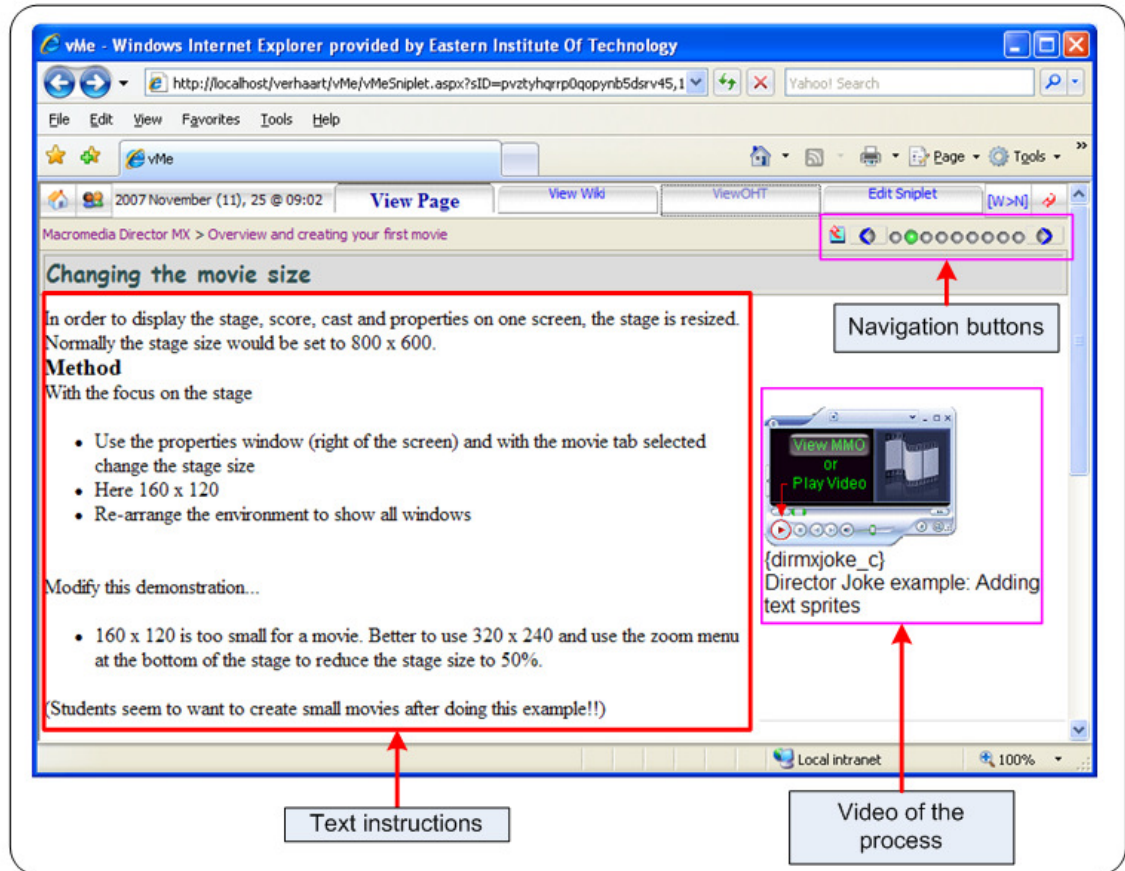


Figure 7-12: Sample Snippet with instructions and related video.

Other features implemented in the prototype to assist in using snippets in a teaching mode include the ability to step through the sequence of snippets without having to return to the main menu. The buttons, shown as balls on the top right of Figure 7-12, can be used to step sequentially through the snippets by using the previous and next buttons (front and rear of balls) or to go to a snippet randomly by hovering the mouse over the balls to display the snippet titles and then selecting the ball corresponding to desired snippet. An additional and very useful feature that was implemented was the ability to use a PowerPoint remote controller to step through the snippets. This has been implemented using JavaScript and an invisible form control.

Allowing students to contribute in a constructivist way to the content was achieved using the annotation facility, as illustrated in Figure 7-2.

### **7.1.5 Conclusion**

When proposing information system frameworks and models, one way they can be validated is by using computer based prototypes to assess whether they are feasible. This chapter presented a prototype that has been developed to validate the virtualMe and annotation frameworks, and the associated models. The prototype has been used successfully between years 2005 and 2007, both as a tool for the researcher and as a teaching and learning environment to demonstrate Web technologies and multimedia techniques to students.

The implementation was designed to show how the framework and models interact and to provide an environment where analysis could be done, and as such there is much that needs to be done to make it into an application that could be used by others. Interest in a system based on the prototype has been expressed when the prototype was presented at various conferences, but this is beyond the scope of the current research.

The following chapter will discuss in more detail implementation and observations for the multimedia object model, a significant area in this research.

## 8            **Action research cycle three: The virtualMe multimedia object**

Previous chapters discussed the design of the multimedia object (MMO) and provided a basic overview. This chapter elaborates on the implementation of the MMO, and consolidates the following book chapters, conference proceedings and presentations:

- *Proceedings of 6th Asia Pacific Conference on Computer Human Interaction*, APCHI 2004, where the MMO was first published (and presented), and subsequently published in *Lecture Notes in Computer Science* (Verhaart, Jamieson & Kinshuk, 2004); and
- “*Cognitively informed systems: utilizing practical approaches to enrich information presentation and transfer*” (Verhaart & Kinshuk, 2006a) as a book chapter, and updated at the *8th Annual Conference of the NZ ACM Special Interest Group on Human-Computer Interaction* (Verhaart & Jamieson, 2007).

In an electronic sense, an overhead can consist of many media elements, or digital assets, such as text, images, sounds, animations, and videos. But a digital asset has other issues that should be considered, for example:

- An image displayed on a computer screen (at 75 dpi) produces poor quality results when produced in hardcopy (600 dpi and above).
- To make a digital asset accessible to the different users of the Internet, there is a significant advantage if it can be represented in multiple formats. For example, to assist screen readers or for those visitors who have sight impairments, an image could be described in text, or alternatively in audio.
- If the digital asset is to maintain its original context and ownership, some metadata needs to be attached to it.
- Another important feature is that the digital asset should have uniqueness and permanency, so that, in the future it can be located.

A significant outcome of this research was a digital asset developed for the virtualMe framework, coined as multimedia object (MMO) (Verhaart, Jamieson, & Kinshuk, 2004, p. 513). An MMO essentially is a manifest of related files, (e.g., multiple images, a related sound file), plus a file that manages the metadata. In order to describe the metadata and associated files, a description language, “*Media Vocabulary Markup Language*” (MVML) was developed (Verhaart & Kinshuk, 2004a), and was based on the standards: extensible markup language (XML), resource definition framework (RDF), Dublin Core, and vCard.

With the large number of digital assets available on the Internet it is common practice to use and re-use these elements in many different contexts. A significant problem occurs when the original context and associated metadata gets lost. When the digital assets, such as images, sounds or videos are created they have specific properties and exist in a specific and describable context. The elements have derived properties such as type, size or, as in the case of sound and video, their duration, and as a rule, these can be automatically generated. To provide context information, data that describes the object, or annotated data, can be added. If the element is part of a group then common properties could be described, and could include such things as the author, possibly the location and maybe some contextual information, such as the event. This metadata could be created in a template and automatically added to the description of an element. Simplistically, the annotated data should be sufficient to describe the digital asset, for example, to a blind person in the case of a visual image, or a deaf person in the case of an audio object.

Humans are capable of classifying and describing millions of such objects, although for most individuals the details will blur over time. Computer systems provide us with a way to store electronic objects, and with sufficient metadata can be used to aid in classifying, managing, searching and re-using these objects in a variety of contexts whilst still retaining their original context.

This chapter describes a model that allows a digital asset to be described in its original context, captures ownership details and annotated metadata, and allows for multiple representations. As humans have variable memory capacities, the representation of a digital asset as a multimedia object will assist multiple cognitive processes by providing alternative representations and appropriate metadata.

## **8.1 Evolution of a multimedia object**

As information and knowledge are not stored just as text, a core part of the virtualMe framework has been the creation, management and organisation of **digital assets** that could exist in many different media types. A digital asset was defined earlier as a computer file containing “unstructured” data, such as text, an image, a video or audio clip, or “structured” data, such as a document (typically containing text and images though it is possible to include animations, sound and video), a spreadsheet, or a database that has been tagged with descriptive information (Ziffdavis, 2003). Typically the descriptive information is in the form of metadata attached to the computer file.

## **8.2 Need and importance of context**

Why is attaching metadata to media objects important? Consider Figure 8-1, which shows images taken on the same bus trip to the Russian Finnish Border.

If a presentation were to be constructed by a person who was not on the trip, and was searching for a photo from a media repository, it would be more likely that one on the right would be chosen as that from the actual Russian Finnish border. In fact, the right hand photo was taken at a tourist stop where a "fake" border was constructed, while the one on the left is taken at the actual border. This is a common problem when sourcing media from a



huge repository such as the Internet, where the context of what is being re-used is lost.



Figure 8-1: Two photos taken during a visit to Russian Finnish border

### 8.3 Problem of missing context or loss of context

There is significant research being undertaken by major organisations such as IBM and Google in the area of deriving context (Fallows, 2004). For example, Google provides an image search facility (<http://images.google.com>), where keywords are used to locate an appropriate image, and the keywords are generated from the context in which the image was found. As before, this can provide many negative hits, for example on a Web page, there can be images of a logo, navigation buttons, unrelated advertising and so on.

Context includes more than just the situation shown in the media element: ownership, and copyright are also important. For example, an image may be re-used many times by many individuals, and details about the original creator of the media object are seldom carried with the object. Thus the creator is often considered to be the author of the page on which the image was found. With the increased awareness of copyright, some institutions, like University of Melbourne (Described by J. Pearce in a personal communication) required lecturers to document ownership details of every media element used in classes.

## 8.4 Need for metadata

So how can contextual information be added to a media element? Data describing the properties of an object is referred to as *metadata*, which is succinctly defined as *data about data*. Many file types have a built-in ability to add information about the element. For example, in Windows Explorer, right clicking on a *jpg* file, and selecting *Properties* then *Summary*, displays the editable information as shown in Figure 8-2.

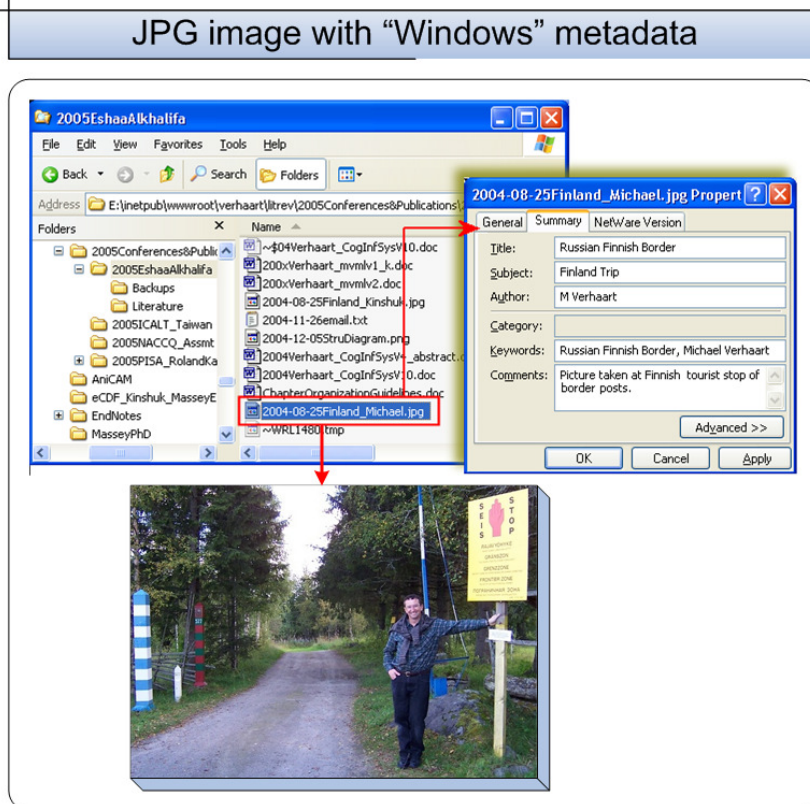


Figure 8-2: jpg file metadata

The ability to attach data about an object, to that object, gives us the ability to describe the object's context.

## 8.5 Need for multiple representations

In the example shown in Figure 8-2, the image could be represented in two ways; as a photo, and as a textual description. The usage will depend on the

context, and additional representations could be desirable in different situations. For example, if a gallery of images were to be displayed, the image should be represented as a thumbnail. If the image was displayed on screen, then it should be sized accordingly, that is, if the image was displayed in a Web browser, it does not make sense to download a 5 Mega-pixel digital camera photo (say 2.5 MB), when the display will only require a 1 Mega-pixel image (350K) (CardMedia, 2008).

In another instance, an image may be explained by an alternative media element. For example, to explain an animated gif two graphic representations are useful, the animated gif itself and a composite static image showing how the gif file is composed (Figure 8-3).

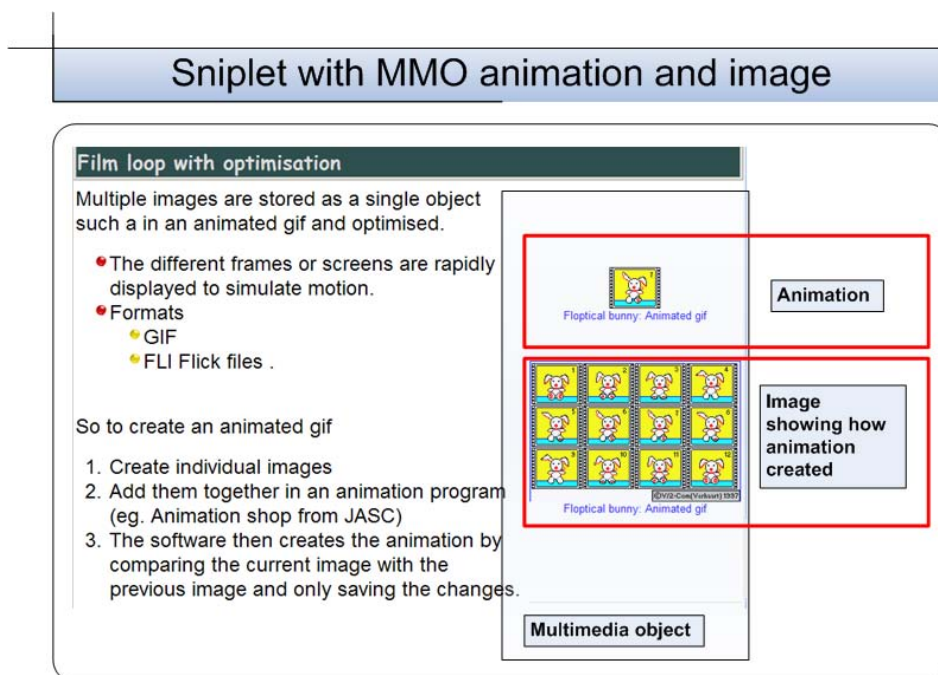


Figure 8-3: Gif file showing animation and composition

The two images are different but closely related, and if the two images could be associated with metadata this would create a useful and usable media object that could be manipulated by a computer. This is referred to as the Multimedia object (MMO), and in the case of the sniplet in the virtualMe, the appropriate representation can be selected from the MMO. Further, if a description is available in the metadata file, it can be used to automatically

display a caption, and if a fuller description were available, this could be used to provide information suitable for a screen reader to process. Other associated data could provide useful information on a Web page, for example, displaying the size of a video or sound file could help the user decide whether or not to download it.

Expanding the multiple representation idea further, if a video media element is considered, four representations are desirable: the actual video, a thumbnail, a representative static image, and a textual description. When a video is displayed on a Web page, the first frame is rendered on the screen. Often this does not assist in identifying the contents of the video. Therefore, an alternative static image may be desirable, for example, a video of a New Zealand kereru bird (native pigeon) may start with a clip showing the bird as part of a bush scene (shown on the left in Figure 8-4), which progresses to the kereru (shown on the right in Figure 8-4). The textual description could be provided for searching and as an alternative representation for those with a visual impairment.



Figure 8-4: Frame images from a video, at left the first frame showing a kereru bird in a bush setting, and right the kereru is clearly discernable.

Commercial products recognize the performance gain in maintaining a thumbnail representation of an image, that is, it is quicker to display the thumbnail images (probably about 1 KB each) as opposed to the full image. Thumbnail files are created by applications such as: Microsoft Windows (thumbs.db), and PaintShop Pro (pspbrwse.jbf). One drawback of this

method is that the thumbnail file is folder based and not explicitly linked with the image. So, if the image is moved, the thumbnail needs to be regenerated.

Therefore a desirable feature for working with electronic media is the ability to manage multiple representations. This allows for an appropriate format to be displayed to an end user depending on the required context.

## **8.6 Sharable digital assets and the need to retain contextual information**

### **8.6.1 What contextual information is required?**

A title is probably the most significant piece of contextual information, followed by the creator of the digital asset. This information can often yield a significant amount of implicit knowledge (Dienes & Perner, 1999), for example, an image of a forest with small upright silver birches, taken in 2004 by one of the researchers would indicate to them a Finnish landscape, whereas for others, this would probably not be the case.

Referencing information, such as the source, publisher and, on the Web, universal resource locator (URL), are also important. For example, an article may contain a diagram or image taken from another article, and the original context would be the article it was embedded in.

Situational annotations, that describe the media element, are an important part of the attached contextual information. For example, the image of the Finnish forest described previously, would have no specific or contextual meaning to anyone who could not identify the scene information such as the trees in Finland. Situation annotations would significantly help in providing the correct context in such situation.

User annotations (made by someone other than the author) also enable contextual information to be attached. Consider the case of a painting from

a famous artist like Picasso. Annotations added by an expert on Picasso's paintings would greatly improve the contextual information of the image's content.

### **8.6.2 Multiple representations are required for different contexts**

As discussed previously, there are benefits in having multiple representations of the same content, for example, an electronic image could have four basic representations: thumbnail, computer display, printable (most often the original) and textual. It was discovered that an image wider than 595 pixels on a Web page would be cropped when printed, and that using the Web browser to resize an image to fit to a Web page would often render the image unreadable. Therefore, having an image resized in a drawing application to 595 for browser display, and saving the original image for printing was desirable.

How can a digital asset be represented with multiple files? The first option is to embed multiple files in one single file. An image file using the Portable Network Graphic (PNG) format is capable of multiple representations of an image in a single file. Adobe's Portable Document Format (PDF) file, Microsoft's Document file (DOC) format, and the Multipurpose Internet Mail Extension HTML (MHT) are other examples.

The second option is to put the files into a wrapper, and many learning object repositories use the ZIP file format to keep the files together. Substantial research in representing multimedia objects has been done by the Motion Picture Experts Group developing MPEG-21 (Bormans & Hill, 2002), and by the organisations and individuals involved in the aceMedia (2004) project. Many package formats are in use on the Internet. These include: widgets (Mozilla Firefox) and gadgets (Windows Vista), Microsoft's Office 2007 and the OOXML file formats (e.g. docx), and the Open Office Open document format (ODF). In many cases they are actually zip archive

files with unique file extensions. The advantage of this approach is that all files are kept together as a unit, while a disadvantage is that specialized software is required to extract the files.

The third option is to keep the files separate and use a naming convention to keep the files together. This option is available in Microsoft's Internet Explorer where the main HTML file is saved along with the creation of a folder of the same name containing the included files. A disadvantage of this approach is that files can become separated, while its advantage is that specialist software is not required to view the files.

The first option requires considerable design and implementation skills and the widespread adoption of the standard, and the second option requires specialised software for extraction. Hence, for the virtualMe the third option was chosen.

Researching existing packaging specifications, particularly in the learning object implementations such as CanCore (2006) or UK-LOM Core (Campbell, et al, 2004) the files stored in the manifest are renamed and often take the form filexxx. Unfortunately, this creates an issue when an element is separated from the learning object. A solution to this problem is to create a file name for the MMO then store all of the files with the same name and include a caret (^) suffix.

For example, if the core digital asset was called 2004Verhaart\_FinlandRoad.jpg, then associated MVML metadata file would be 2004Verhaart\_FinlandRoad.mvml. A thumbnail of the file could be called 2004Verhaart\_FinlandRoad^.jpg, and an image formatted for the screen 2004Verhaart\_FinlandRoad^w595.jpg. Figure 8-5 shows how a single digital asset could be represented by a manifest of related files and the MVML metadata file.




MMO: Driving in Finland				
		File manifest		
Name	Size	Dimensions	Type	Date Modified
2004Verhaart_FinlandRoad.mvml	2 KB		MVML File	18/10/2004
2004Verhaart_FinlandRoad.doc	20 KB		Microsoft Word Doc...	29/11/2004
2004Verhaart_FinlandRoad.jpg	452 KB	1656 x 1242	Paint Shop Pro 5 Im...	5/09/2004
2004Verhaart_FinlandRoad.mid	22 KB		vanBasco's Karaoke...	19/08/2001
2004Verhaart_FinlandRoad.mp3	2,293...		MP3 audio file (mp3)	25/04/2003
2004Verhaart_FinlandRoad.ppt	8 KB		Microsoft PowerPol...	29/11/2004
2004Verhaart_FinlandRoad.wav	55 KB		Wave Sound	19/08/2001
2004Verhaart_FinlandRoad.wmv	530 KB	800 x 600	Windows Media Aud...	20/02/2003
2004Verhaart_FinlandRoad^.jpg	3 KB	94 x 70	Paint Shop Pro 5 Im...	24/11/2004
2004Verhaart_FinlandRoad~w295.jpg	17 KB	295 x 221	Paint Shop Pro 5 Im...	25/11/2004
2004Verhaart_FinlandRoad~w595.jpg	47 KB	595 x 446	Paint Shop Pro 5 Im...	25/11/2004

Figure 8-5: MVML file manifest

### 8.6.2.1 A model to manage a manifest of related files

After evaluating several prototypes, a workable model evolved, consisting of a file containing the textual metadata for the digital asset and associated files in their original formats. In order to describe this collection of files the term multimedia object (MMO) was coined (Verhaart, Jamieson & Kinshuk, 2004, p. 513), as illustrated in Figure 8-6.

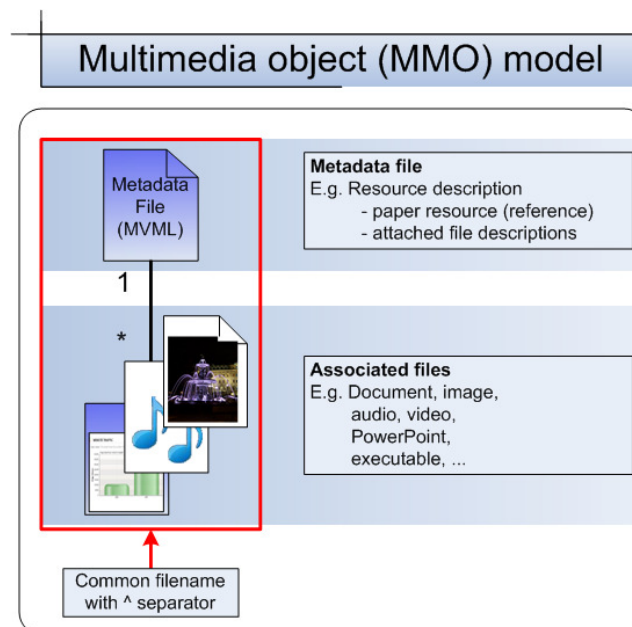


Figure 8-6: Multimedia Object (MMO) Model

As discussed previously, many Web based systems use a thumbnail of an image with a hypergraphic link to the actual image, as this improves



download speed and minimizes bandwidth requirements. So in essence if there are multiple occurrences of a file available for display, the appropriate one for the context can be chosen. If an image is considered, it would be an advantage to have other forms available, for example, if a user is blind, a textual description for use by a screen reader could be attached, or alternatively a verbal description could be provided. So, a digital asset may exist as an image file, and iconic image file, a sound file describing the image file and so on. Attaching a file that describes the collection has been described in an eXtensible Markup Language (XML) metadata file, and a structured language named Media Vocabulary Markup Language (MVML) used.

In order to have a viable way to manage digital content it is important that the creation of an MMO is straightforward, and any metadata conforms to current practice and standards. To enable the metadata to be structured and to describe the information about the associated manifest of files, a mark-up language was developed. This language:

- conforms to existing standards;
- manages derived information such as file name, type and size; and
- manages annotated information, including:
  - the contextual information such as situational data;
  - creator information;
  - bibliographic information; and
  - additional annotation information that may be added later when the digital asset is reused.

To illustrate how an MVML file could be created by an end-user, a workstation prototype was developed, allowing basic metadata entry (Figure 8-7). A template based on XML was developed that could auto-generate the form and will be described later in the chapter.

# MVMLL metadata input form

The screenshot shows the "MVML File generator" application window. The title bar indicates it's a prototype version from 2004. The main area displays the "Annotated" view of a file named "sbar\_bella00.jpg". A red box highlights the "View Fields" section, which contains several input fields for metadata:

- Title: MVML file sbar\_bella00.mvml exists
- Subject: Side bar image
- Copyright: Copyright 2004 M H Verhaart. All Rights Reserved
- Context: (empty field)

To the right of these fields are instructions: "Enter keywords separated with a comma" and "Describe the resource as if to a blind person". Below the fields is a counter showing "0". At the bottom of the window are "Save" and "Exit" buttons.

A red arrow points from the "Context" field to a corresponding XML snippet in the code block below.

```
<dc:title>"Title[*)"||^</dc:title>  
<dc:subject>"Subject|Side bar image|Enter keywords separated with a comma"</dc:subject>  
<dc:rights>"Copyright|Copyright ^D:yyyy;^ M H Verhaart. All Rights Reserved|^</dc:rights>  
<mvml:context>"Context||Describe the resource as if to a blind person"</mvml:context>
```

Figure 8-7: Original input form for creating an MVML file showing links to the template

The template was used to structure the annotated data (such as, title and context) (Figure 8-7), plus derived metadata (which could be extracted by the computer, e.g. for an image: size, type and creation date).

The template has proved to be an important concept enabling quick creation of annotated metadata. For example, as the virtualMe framework is essentially the creation of a personal space, the creator of any items within this space will be “me”. So the creator information can be entered into the template and this can be automatically included in the MVML file attached to the digital asset.

The basic MMO was first trialled in the V/2-Online prototype as a sidebar image, and is illustrated in Figure 8-8 showing: the image of a fountain, and the associated MVML. Notice that the *title* has been used to caption the image, and how the MVML file could be transformed to create other metadata formats, in this case an EndNote format and APA format.

## MVML metadata file for an image

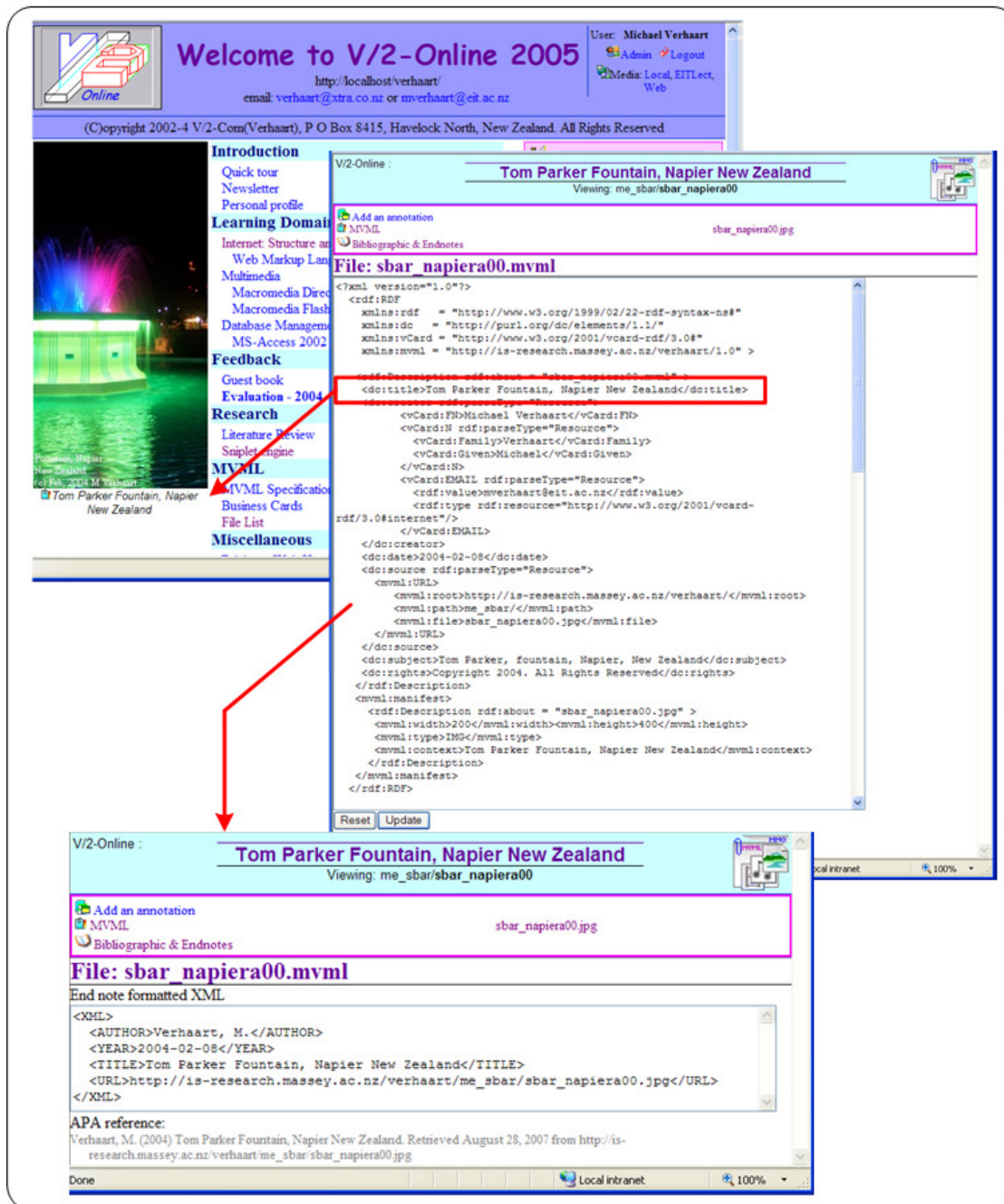


Figure 8-8: V/2-Online (version 2) showing image with caption plus EndNote and APA reference

The model could be configured in a variety of ways. Firstly, the MMO could consist of just the MVML file, and this could be where plain text is the only required media object, or the MMO is a URL reference to a web site or physical book reference.

Secondly, and this would be the more common case, an MMO could consist of an MVML file and one or more associated multimedia files that used the caret (^) convention.

The virtualMe prototype developed showed that the format works for all types of multimedia and coped with legacy and multimedia object types that emerged during the research.

### **8.6.3 Managing referencing information such as rights and copyright**

Media elements can come from two sources: the creator or external. The goal of the MMO was to create a sharable object, and therefore, whether it has been created or copied, rights and copyright information need to be captured.

Created objects may be built using an authoring tool (software designed to produce a media element such as a drawing program) or captured from an electronic device, such as a digital camera. For media created by an individual the rights and copyright metadata will fundamentally be the same, and would contain the creator's details and copyright notice.

In the case of "*borrowed*" objects, this becomes less clear. The Web is a tool for information gathering and rearranging, and most media elements lose the rights and copyright information, as such information is mostly placed on the webpage rather than attached to the element. The ability to create an associated metadata file with each media element can help to keep the rights and copyright information.

Digital rights information is probably the most complex and many standards leave the design and implementation up to the developers or users of the respective standard. Powell and Johnston (2003) provided some guidelines as to how Open Digital Rights Language (ODRL) can be mixed with Dublin Core (2008a), and these have been followed in the MMO.

#### **8.6.4 The need for standards and to adopt existing standards**

In order to make the sharing of media elements possible, a set of standards needs to be developed, for example, if an image from an external website is to be used, the associated metadata can be browsed to extract content, context and rights information.

Libraries have been working with these issues for many years, and Dublin Core (2008a) is the most common standard for digital works. The publishing industry has developed the Publishing Requirements for Industry Standard Metadata (PRISM) (Daniel, Hansen, & Pope, 2003).

A major initiative in progress on the Internet is the development of a framework of technologies for the Semantic Web (W3C, 2008a; Knorr, 2002; Ford, 2004). Baker (2002) describes the Semantic web as one "that will allow machines to easily understand and work with the words and information humans stuff into e-mails, documents and databases. Many time-killing clerical tasks that today require a live person at the keyboard could be automated."

Two important standards that are part of the Semantic Web are: the eXtensible Markup Language (XML) (W3C, 2008b) and the Resource Definition Framework (RDF) (Herman, Swick, & Brickley, 2007). XML allows data to be represented in a common and structured way and is a suitable container to describe the metadata. The Resource Definition Framework (RDF) uniquely identifies a resource whether electronic or not. Kuchling (2002) stated that "RDF is ... aimed at building a web of information that's easy for machines to read".

#### **8.6.5 User interface design considerations**

The three phases of: creation, viewing and sharing were carefully considered when designing the MMO.

The software to create the MVML metadata for the MMO is probably the most complex. While many users are permanently connected to the Internet, many are not, therefore, when designing MMO creation software it is important that it can run in standalone mode as well as in an Internet mode. Further, it would be an advantage if the software could auto-generate the standard associated files, for example, when the MVML file for an image is created, a thumbnail should also be created.

Viewing an MMO can be generalized, but the amount of change required in existing media players should be minimal. At present a Web browser would be the most obvious viewer choice, because it can cope with the many different media types. An additional requirement for the MMO was the ability to accept annotations, which increases the complexity. An advantage of the MMO with its multiple associated files is that cognitive loading can be decreased for each media element. Work on exploration space control (Kashihara, Kinshuk, Oppermann, Rashev, & Simm, 2000) emphasises the display of optimal amounts of information on screen to reduce cognitive overload. A system utilizing the MMO should be able to display an appropriate media object from the manifest, and provide a link to the additional related objects in the manifest.

The sharing of an MMO required a standardised copying facility, although at present the MMO is a collection of separate files which makes a simple download difficult. The ability to create an on-the-fly package, such as a zip file, which auto-extracts on successful download, would be a possible solution. Since an MMO can be shared and subsequently modified or annotated, it is necessary to build-in the capability to update the original MMO, for example, when a sound clip attached to a MMO is redone to improve audio quality or when an annotation has been added.

Figure 8-9 illustrates an MMO model and how a human or computer could interact with the system

## Multimedia object (MMO) interfaces

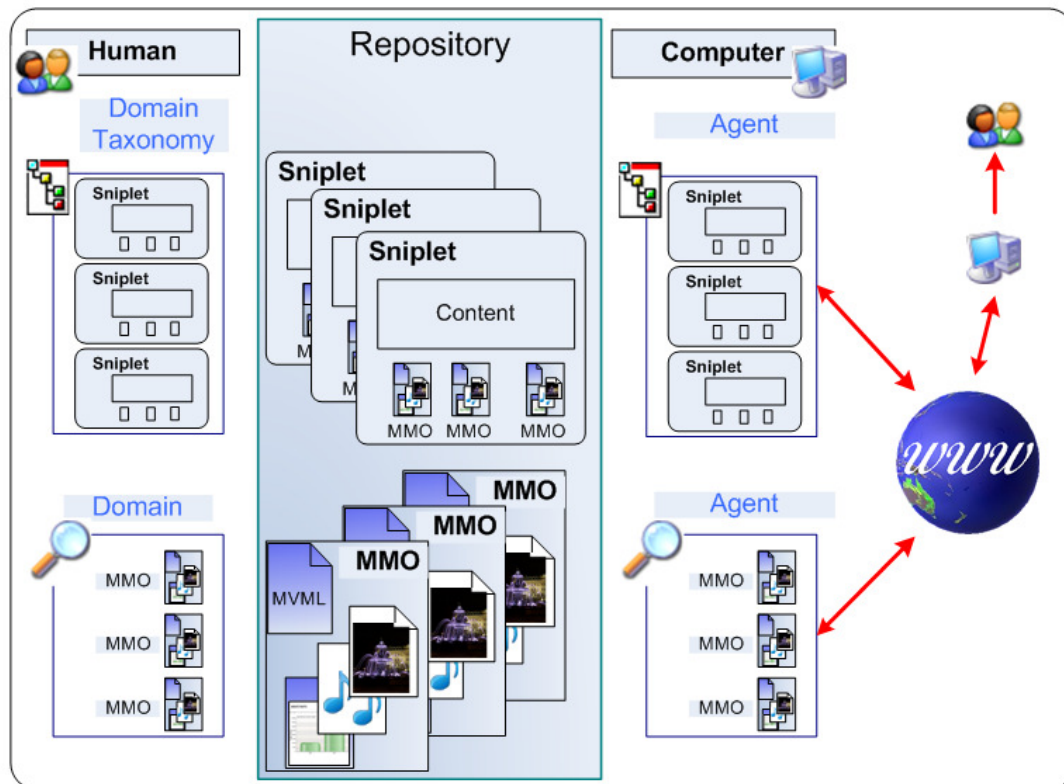


Figure 8-9: MMO electronic repository, human and computer interfaces

The centre column represents an electronic repository of snippets and MMOs. An MMO is made up of an MVML file and associated files, while a snippet can be made up of the content and related MMO's. It should be noted that individual MMO's could be used by multiple snippets.

A human can interact with the repository either via a domain taxonomy that provides a structure to the repository, or using a search on the MMOs.

The computer-assisted generation of content is probably the most significant benefit of the MVML structure. If a repository is structured in a consistent and uniform way, other systems could access the resources and produce meaningful results. For example, if a course was being developed on house building and an image of framing in a wooden house was required, electronic agents could search through servers that have MVML compliant



resources and could produce accurate results, and additionally, if context and content metadata were present, associated information and knowledge. Indeed it should be possible for much of the content to be automatically generated.

An example of interfacing an HTML Web page to a repository is YouTube, as illustrated in Figure 8-10. Here the HTML object tag is used to link to the YouTube flash video repository and the video to be linked is “9zMFsm3QBic”. For YouTube only three parts of the interface code are changed: the height, width and file code. (Note that in the example, the YouTube video is actually encapsulated in an MMO).

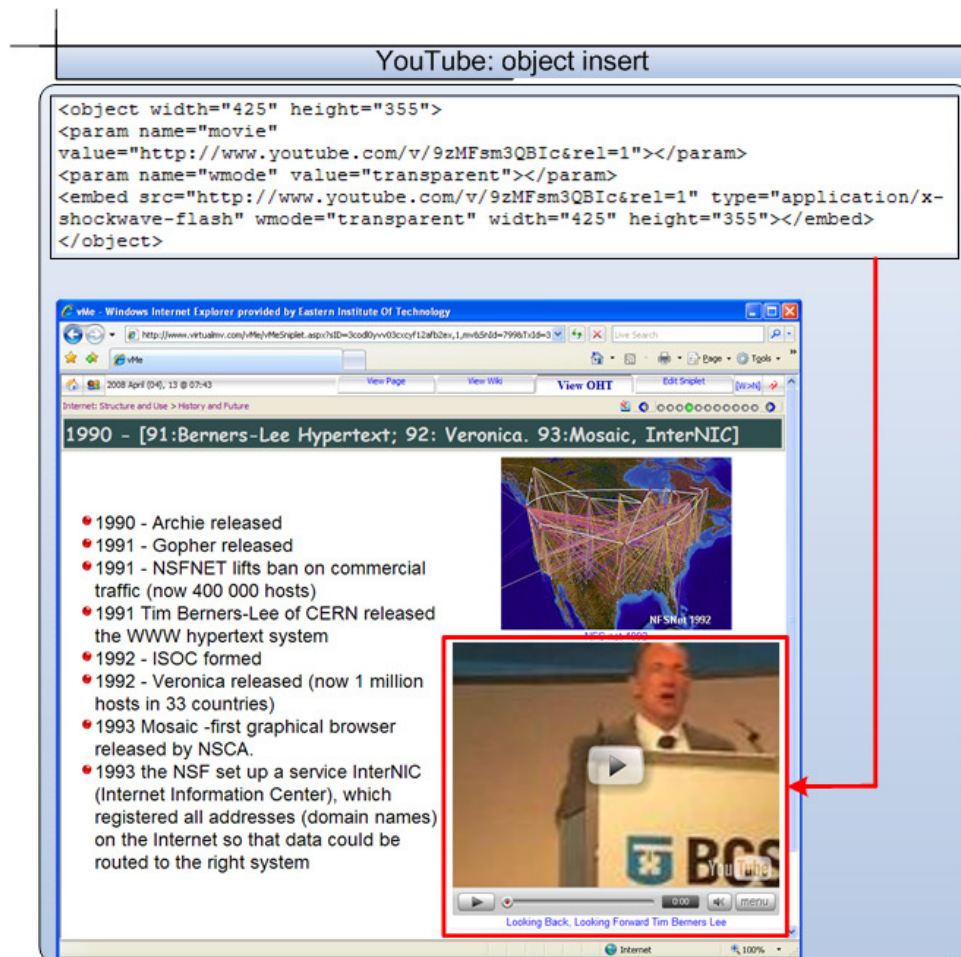


Figure 8-10: YouTube Object definition



### **8.6.6 Ability to re-aggregate if individual elements become separated**

One issue surrounding existing metadata schemas is the inability to re-aggregate if elements become separated. Many learning object (LO) metadata schemas name a media element as `file000xxx` within the manifest. Unfortunately if a file becomes separated from the LO it has no identifying features to help locate the original LO. In the MMO the caret (^) convention addresses this issue.

So if a file is separated, using a search engine it is possible to locate the rest of the MMO by looking for the *filename.mvml* file, or *filename.zip* (or *mmo*). This is an important design feature of the MMO.

### **8.6.7 Ability to handle legacy and future file types**

Another important facet of the MMO is the ability to handle many electronic file types. This is one of the major drawbacks of providing a wrapping structure such as PDF, MHT (MHTML), and MPEG. Keeping files in their native formats maintains the integrity of the media element. One obvious drawback is that in order to view/playback the element a player is required, for example a video element will require the correct codec to play correctly. This is a problem common to all multi-format systems, but specifying the acceptable formats would limit the usefulness and extensibility of the MMO.

### **8.6.8 Recommendations for naming images**

Although the MMO has been developed to support this research, some of the following techniques could be useful for existing electronic images:

1. Starting file names with the date (yyyymmdd format). The creation date of a file is unreliable (e.g. when copying to a server the creation date will often be the time it was copied to the server). When copying

from a digital camera, some take this as the date copied from the camera rather than the date the picture was taken.

2. Add the author. This is especially useful when working with references, e.g. 2007Verhaart\_eLearn.doc.
3. Add underscore followed by brief title.
4. For related files add ^ and extension.

This will produce a self documenting and reasonably unique filename.

## **8.7 Examples of Multimedia Objects**

In the virtualMe prototype, multimedia metadata has been created for all digital assets. An early proof of concept was built around a business card, and is illustrated in Figure 8-11. An image of a business card can be enhanced with the addition of other representations, such as: a textual equivalent, a photo of the person, a voice clip showing how the name is pronounced, and perhaps a video of the person concerned where other non-verbal information such as mannerisms could also be represented. Also, for people from non-English speaking countries, it is common that the business card is double sided, with one side being in the language of the person and the other generally in English. A popular text format for representing a business card is vCard, or its XML equivalent, xCard (Ianella, 2001).

## virtualMe MMO (MVML + Collection)

Virtual Michael Verhaart

MMO/MVML package viewer Michael Verhaart

Verhaart, M. H. (2005-01-22) MMO/MVML Viewer: Michael Verhaart. Retrieved September 06, 2007 from /verhaart/Me/MePublic/MeMVML.aspx?mvml=Verhaart\_M&path=db/Me\_mv/buscard/

MVML APA Reference Dublin Core vCard Endnote

Verhaart\_M.jpg [buscard] Small business card

Verhaart\_M.jpg [thumbnail] Photo

Verhaart\_M\_w200.jpg [alternative] Photo outside EIT

Verhaart\_M.htm [cv] Personal Profile

Verhaart\_M.rss [rss] RSS 1.0 :5 most recent Annotations

Verhaart\_M\_bcard.jpg [bcard] Business card

MMO Collection

MVML

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf = "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc = "http://purl.org/dc/elements/1.1/"
  xmlns:dcterms = "http://purl.org/dc/terms/"
  xmlns:vCard = "http://www.w3.org/2001/vcard-rdf/3.0#"
  xmlns:oeex = "http://odrl.net/1.0/ODRL-EX"
  xmlns:odd = "http://odrl.net/1.0/ODRL-DD"
  xmlns:mvml = "http://is-research.massey.ac.nz/verhaart/1.2" >

  <rdf:Description rdf:about = "Verhaart_M.mvml" >
    <dc:title>Michael Verhaart</dc:title>
    <dc:date>2005-01-22</dc:date>
    <mvml:today></mvml:today>
    <mvml:RawUrl></mvml:RawUrl>
    <mvml:people bag="1" >
      <mvml:Person>
        <dc:creator>Verhaart, M.</dc:creator>
        <vCard:FN>Verhaart, Michael</vCard:FN>
```

Dublin Core

APA Reference

VCard

Personal profile

Business card

Verhaart, M. H. (2005-01-22) Michael Verhaart. MMO/MVML Viewer: Retrieved September 06, 2007 from %2fverhaart%2fMe%2fMePublic%2fMeMVML.aspx%3finvml%3dVerhaart\_M%26path%3ddb%3d%2fMe\_mv%2fbuscard%2f

Michael Verhaart: Personal Profile

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Figure 8-11: Multimedia Object (MMO) of a person

Figure 8-12 shows a screen shot of a snippet where the MMO is included as an image collage and a sound clip. Clicking on the displayed MMO hyperlink pops-up an MMO viewer with a list containing the MVML file and associated files. Two of the possible XSL transformations are shown: the APA reference and the Endnote XML file.

**Snippet:MMO:MVML – Software illustration**

The screenshot displays a web browser window with the following content:

- CD-ROM - Need 4 Speed II (1997)**
- Profile**
  - Manufacturer: Electronic Arts
  - www.nfs2.com (no longer active)
  - Year 1997
  - Description 3-D Car racing simulation. 12 possible cars. Includes profiles on the vehicles.
- Reference : Need for Speed Version 2 ( www.nfs2.com)**
- MMO/MVML package viewer Michael Verhaart**
  - Verhaart, M., (2006/01/23) MMO/MVML Viewer: Need for Speed CD-Rom Example. Retrieved March 24, 2007 from /verhaart/vMe/vMePublic/vMeMVML.aspx?mvml=n4speed2&path=db/vMe\_mv/mmedia/
  - Buttons: MVML, APA Reference, Dublin Core, vCard, Endnote
  - File list:
    - n4speed2.jpg [original] Need for Speed CD-Rom Example
    - n4speed2.wav [audioclip] Need for Speed II, introduction sound file
    - n4speed2^ .jpg [thumbnail] Need for Speed CD-Rom Example
    - n4speed2^con.jpg [con] Need for Speed CD-Rom Example
    - n4speed2^menu.jpg [con] Need for Speed CD-Rom Example (Menu)
    - n4speed2^vid.jpg [con] Need for Speed CD-Rom Example (Image of video clip)
  - APA Reference output:

```

Electronic Arts (2006) Need for Speed CD-Rom Example. Retrieved January 2:

```
  - Endnote XML output:

```

<?xml version="1.0" encoding="utf-16"?>
<XML>
<RECORD>
<REFERENCE_TYPE> <REFERENCE_TYPE>
<AUTHORS>
<AUTHOR>Verhaart, M.</AUTHOR>
</AUTHORS>
<YEAR>2006/01/23</YEAR>
<TITLE>Need for Speed CD-Rom Example</TITLE>
<SECONDARY_TITLE></SECONDARY_TITLE>
<VOLUME>2006</VOLUME>
<NUMBER>January 23</NUMBER>
<PAGES></PAGES>
<URL></URL>
<publisher></publisher>
</RECORD>
</XML>

```

Annotations on the right side of the screenshot:

- Image**: Points to the collage of game screenshots.
- Audio**: Points to the audio player for 'Need for Speed CD-Rom Example'.

Figure 8-12: Multimedia Object (MMO) of software product

## **8.8 Multimedia Objects (MMOs) and MVML**

### **8.8.1 The Multimedia object model**

Figure 8-6 illustrated the basic structure of the multimedia object containing a Multimedia Vocabulary Markup Language (MVML) file and associated manifest of media files. This section will consider what metadata could be included in the MVML file, what standards would be appropriate to follow, and the design outline for MVML.

### **8.8.2 What metadata needs to be attached to a digital asset?**

There are two kinds of metadata that can be attached to a digital asset: derived and annotated (Goldfarb & Prescod, 2002). Derived data can be extracted from the electronic file itself, for example, the name of the file or its physical size. There are many advantages in capturing this information implicitly rather than getting the application to retrieve this information each time it is needed. For example, a thumbnail of an image with a description and its physical size can be quickly displayed to allow the user the choice of accepting or not accepting the download. Also, as media can exist in formats that are not available to the client system, such as, when a plug-in is required, the user can decide whether installing the appropriate software is warranted.

Table 8-1 suggests derived metadata for media elements.

Table 8-1: MVML Derived metadata

Attribute	Un-structured					Structured
	Text	Image	Animation	Audio	Video	
Filename	✓	✓	✓	✓	✓	✓
Size	✓	✓	✓	✓	✓	✓
Width		✓	✓		✓	
Height		✓	✓		✓	
Duration				✓	✓	

Note that a file containing many media elements such as a PowerPoint presentation are examples of a structured media file.

Annotated metadata is that which is added by the user. In order for an MMO to have an existence, it must have the mandatory field "title". This is consistent with database schemas where a *primary key* is defined, or in the physical world where a person is given some sort of identifier, for example, a name. Table 8-2 presents a preliminary list of annotated metadata attributes for an MMO.

Table 8-2: MVML annotated metadata

Attribute	Comment
Title	Mandatory. Short description of object
Creator	Format: prefix (Mr, Ms, etc.), family name, given name and contact details (email, URL)
Subject	Keywords
Rights	Copyright details
Context	For example, an image should be described to accommodate blind viewers.

Note that the use of the word “creator” as opposed to “author” is consistent with the Dublin Core standard which is described in the following section.

### 8.8.3 Existing metadata standards

There are many groups working collaboratively designing common metadata standards, and the ability to describe an object in a structured manner is an important way in which objects can be classified and organized. For example, in a database, metadata about a student, employee or client are used to clearly identify them. Defining standards is essential for developing sharable objects.

There has been much work in defining objects used in learning. McGreal and Roberts (2001) discuss the levels of granularity, and define the simplest level as being the information object or *component* (e.g., simple text or a photograph). Learning object specifications that are relevant include IEEE 1484.12.1-2002 or LOM (Dray, 2005), Dublin Core Metadata Element Set (DCMES) (Dublin Core, 2008b), and Sharable Content Object Reference Model (SCORM) (ADL, 2006). These standards are then used in metadata schema implementations, such as CanCore (2006) or UK-LOM Core (Campbell, et al., 2004). A comparison of LOM Core Application Profiles can be found in Appendix 3 of the UK LOM Core draft specifications (Campbell, et al., 2004).

Friesen, Fisher, and Roberts (2004) described the rationale for developing CanCore as opposed to using *the Learning Object Metadata standard (IEEE 1484.12.1-2002 or LOM; also known as IMS Learning Resource Metadata)* as follows:

*"The LOM is both complex and general in character, contains a broad range of elements, and leaves open many possibilities for interpretation. CanCore seeks to simplify and interpret this standard in order to help implementers and record creators with design, development, and indexing work."*

After considering various metadata standards, the MVML language was based on Dublin Core, vCard(xCard) and the Resource Definition Framework (RDF).

#### 8.8.4 MMO:MVML architecture

Figure 8-13 illustrates the MMO architecture (Verhaart & Jamieson, 2007, p. 75). The complete MMO is made up of an MVML file and associated media, and this can be interpreted by a computer based application to generate an appropriate screen display. Using extensible Style Language (XSL) transformations, the metadata can be used to generate suitable schemas for existing standards such as Dublin core, APA referencing (and others if the XSL is developed), xCard, and EndNote.

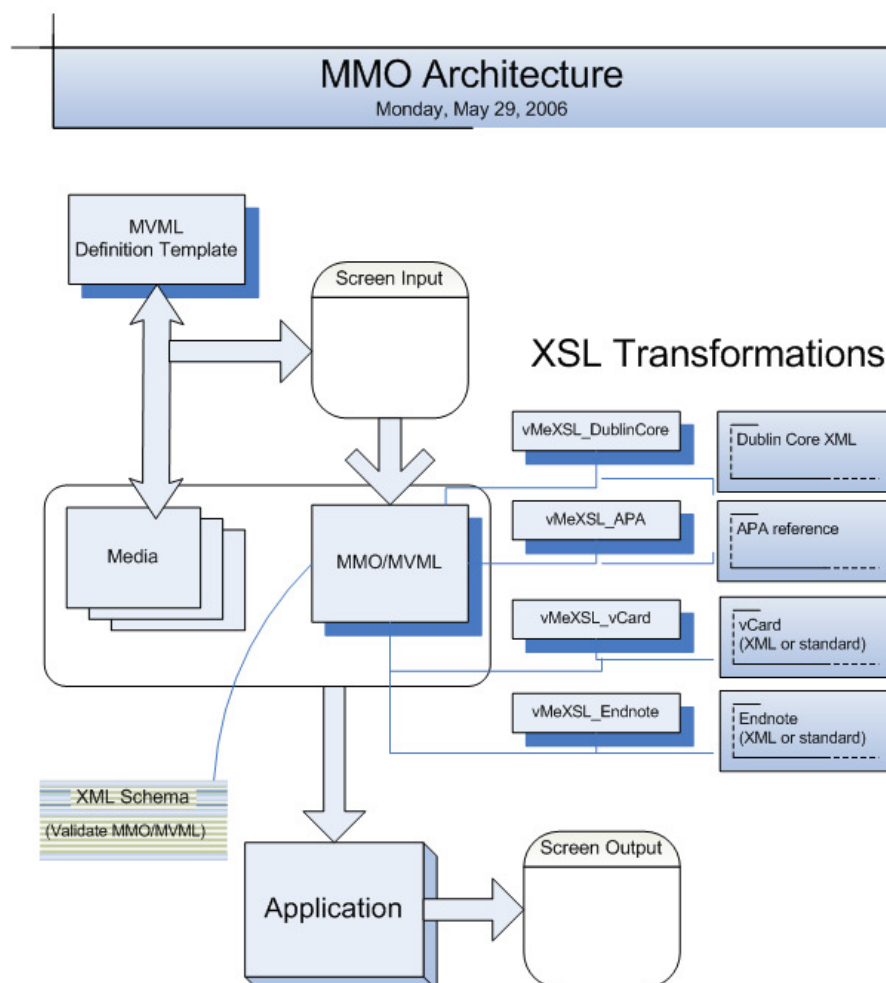


Figure 8-13: MMO Architecture



To allow for template driven creation of the MVML XML file, a data-input specification has been developed (Verhaart & Kinshuk, 2006a), and this will be described later in this chapter.

### **8.8.5 MVML a markup language to describe a digital asset**

In developing a way to capture knowledge at source, it is acknowledged that knowledge can exist in a variety of ways. Typically knowledge has been captured in a textual form on the Internet, using email systems, bulletin boards and the like. But multimedia elements should be considered when knowledge is to be captured. For example, a diagram may be used to describe a concept, a video to describe a process and so on. Further, the knowledge may be represented in a variety of formats and presentation can depend on the context in which it is being accessed. So there is a requirement to have the knowledge represented in a variety of forms, using a set of common standards.

#### **8.8.5.1 Example of MVML for a Multimedia Object**

Figure 8-5 illustrated an image of driving in Finland and a file manifest. An excerpt of the associated MVML file is shown in Figure 8-14, and illustrates the three part structure: overall metadata (the meta-metadata), the manifest containing a list of the associated files and their properties, and the annotations section allowing users to add comments directly to the MMO.

## MMO MVML File: Driving in Finland

```

<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf = "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc = "http://purl.org/dc/elements/1.1/"
  xmlns:vCard = "http://www.w3.org/2001/vcard-rdf/3.0#"
  xmlns:MVML = "http://is-research.massey.ac.nz/verhaart/1.0" >
  Meta-metadata used by all files in the manifest
  <rdf:Description rdf:about = "2004Verhaart_FinlandRoad.MVML" >
    <dc:title>Driving on the Right Hand side of the road in Finland</dc:title>
    <MVML:creators>
      <dc:creator rdf:parseType="Resource">
        <vCard:FN> Michael Verhaart</vCard:FN>
        <vCard:N rdf:parseType="Resource">
          <vCard:Family>Verhaart</vCard:Family><vCard:Given>Michael</vCard:Given>
          </vCard:N>
          <vCard:EMAIL rdf:parseType="Resource">
            <rdf:value>mverhaart@eit.ac.nz</rdf:value>
            <rdf:type rdf:resource="http://www.w3.org/2001/vcard-rdf/3.0#internet"/>
          </vCard:EMAIL>
        </dc:creator>
      </MVML:creators>
      <dc:date>2004-12-27</dc:date>
      <dc:source rdf:parseType="Resource">
        <MVML:URI>
          <MVML:root>http://is-research.massey.ac.nz/verhaart/</MVML:root>
          <MVML:path>me_media/2004Finland</MVML:path>
          </MVML:URI>
        </dc:source>
        <dc:subject>Finland, Joensuu, Taxi, Lights</dc:subject>
        <dc:rights>Copyright 2004 M H Verhaart. All Rights Reserved</dc:rights>
        <MVML:context>Finland, Joensuu, Fri 3 Sep photo through windscreen of taxi to
        airport. PDA on dashboard, truck approaching with lights on. Black car with trailer and
        planks in front. All cars have lights on during day.</MVML:context>
      </rdf:Description>
      manifest of the associated files with their attributes
      <MVML:manifest>
        <rdf:file rdf:about = "2004Verhaart_FinlandRoad.jpg" >
          <MVML:derived>
            <width>1656</width><height>1242</height><size>462810</size>
          </MVML:derived>
          <MVML:annotated>
            <type>image</type><subtype>basic</subtype><use>original</use>
          </MVML:annotated>
        </rdf:file>
        <rdf:file rdf:about = "2004Verhaart_FinlandRoad^1.jpg" >
          <MVML:derived>
            <width>94</width><height>70</height><size>3072</size>
          </MVML:derived>
          <MVML:annotated>
            <type>image</type><subtype>basic</subtype><use>thumbnail</use>
          </MVML:annotated>
        </rdf:file>
        <rdf:file rdf:about = "2004Verhaart_FinlandRoad^w595.jpg" >
          <MVML:derived>
            <width>595</width><height>446</height><size>47791</size>
          </MVML:derived>
          <MVML:annotated>
            <type>image</type><subtype>basic</subtype><use>display</use>
          </MVML:annotated>
        </rdf:file>
      </MVML:manifest>
      Attached annotations
      <MVML:annotations>
      </MVML:annotations>
    </rdf:RDF>
  
```

Figure 8-14: MVML file for MMO driving in Finland

### 8.8.5.2      **Derived metadata**

Reviewing Figure 8-14 reveals that many of the values can be generated by computer software. For example; the date when the MVML file was created (<dc:date>), and the attributes of the files in the manifest (such as width, height and size of images). Hence this makes it possible to create much of the metadata automatically.

Due to the ambiguous nature of a date (e.g., 05-06-2004 can be June 5<sup>th</sup> or May 6<sup>th</sup> ), the unambiguous date format (Wolf & Wicksteed, 1997) YYYY-MM-DD (ISO 8601) was adopted for MVML. Other metadata standards, such as CanCore (Friesen, et al., 2004) have also adopted this date format.

### 8.8.5.3      **Annotated metadata**

In Figure 8-14 parts such as title, subject and context (in bold) relate specifically to the image being coded. Other values such as the creator's name could be inherited (as discussed in the following section). This illustrates that the actual amount of metadata to be entered by the user is actually quite manageable.

In MVML, title is a **mandatory** field, though an interesting observation is that many metadata schemas, such as Dublin Core and LOM, do not have any mandatory fields.

The **context** and **keywords** attached to the resource are potentially the most beneficial part of the MVML model. Simply put this is equivalent to “a description of the object that could be interpreted by a blind person”. The downside is the necessity to create the metadata and as indicated by Phillips (2000) and contributors in the IFETS Forum (<http://ifets.ieee.org/>), this is a major problem in terms of adoption of metadata systems. It is expected that, using Internet technologies, the capturing of metadata will be at the source (from users), and MMO's will have mechanisms that will allow

for synchronization where an MMO has been copied and additional metadata added.

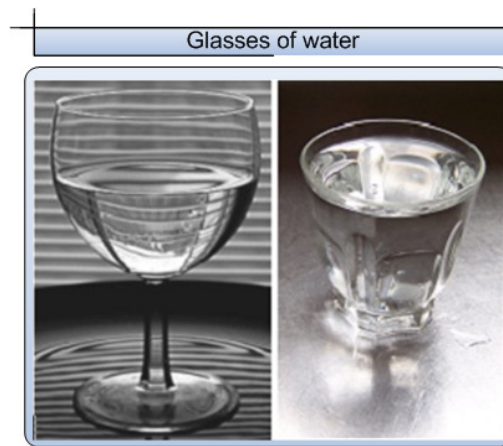


Figure 8-15: Two Images of “a glass of water”.

Using the glass in Figure 8-15, keyword and context metadata could be as follows;

- **Keywords:** Cooking, drinking, water.
- **Context:** A half full [state] clear [adjective] glass [noun] of water [noun] on a table [situation].

Context could contain:

- A **situation**, glass of water on a table, this could also include the time of day, environment, and so on.
- A **state** for a glass: empty, half full, full.
- An **interpretation**, a glass of water, still life abstraction, purity, etc.
- A comment that describes the **mood**, for example a soothing piece of music.

Using a picture of flowers (deliberately not shown), keyword and context metadata could be as follows;

- **Keywords:** Bouquet, painting, plant.
- **Context:** A bouquet [state] of red [adjective] roses [noun] in a vase [situation].

This example is incomplete since the given context is too simplistic to derive a suitable mental picture. The context could include type of vase, surface it is standing on, condition of the roses, the arrangement of the bouquet.

### **8.8.5.4 Inherited metadata**

When creating metadata for a group of MMOs, some of the data may be common. For example, if a collection of images were being codified, it is likely that they would all have the same creator. The ability to create a template with this common information greatly improved the process of creating the MVML file.

### **8.8.6 The XML Template Generator (XTG) for creating the MVML file**

A significant problem that exists is that metadata creation requires manual input by an individual or group. Unless there are real benefits, this will not occur (Phillips, 2000, p. 494). Furthermore, the addition of metadata is often time consuming, with much of the metadata being repeated. In order to facilitate rapid entry of the metadata a template with an embedded coding language was developed. This coding language allows the template's author to specify which entries can be automatically created by the system (the derived data), which data needs to be added by the user (annotated data, such as the title), and which data can be inherited from other data entered by the user (such as full name from given and family name).

A significant outcome of this research is the development of the XML Template generator (XTG). The following discussion summarizes how the XTG is used to create an MVML file, and Appendix B provides a more in-depth description.

The MVML template is made up of two parts: the folder generic template and the MVML manifest media template.

### **8.8.6.1 Folder generic template (FGT)**

The FGT is stored, as the name implies, in the folder with related files. For example, if a collection of images is about a particular country, it would make sense that there would be common metadata. Figure 8-16 illustrates the FGT for a folder containing a collection of images from the ICALT 2004 Conference in Finland.

This template illustrates how common metadata is entered, such as creator's name, and how data to be captured is specified. The semantics of the MVML coding language will be covered after the next section.

## MVML Template example

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf = "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc = "http://purl.org/dc/elements/1.1/"
  xmlns:vCard = "http://www.w3.org/2001/vcard-rdf/3.0#"
  xmlns:MVML = "http://is-research.massey.ac.nz/verhaart/1.0" >
```

The next section shows how the title (a \* for mandatory) and derived data, ^M^ (MVML file) and ^&D^ (date) ) are defined. The creators information is already entered.

```
<rdf:Description rdf:about = "^&M^" >
<dc:title>^Title[""]|^</dc:title>
<MVML:creators>
<dc:creator rdf:parseType="Resource">
  <vCard:FN> Michael Verhaart</vCard:FN>
  <vCard:N rdf:parseType="Resource">
    <vCard:Family>Verhaart</vCard:Family>
    <vCard:Given>Michael</vCard:Given>
  </vCard:N>
  <vCard:EMAIL rdf:parseType="Resource">
    <rdf:value>mverhaart@eit.ac.nz</rdf:value>
    <rdf:type rdf:resource="http://www.w3.org/2001/vcard-rdf/3.0#internet"/>
  </vCard:EMAIL>
</dc:creator>
</MVML:creators>
<dc:date>^&D^</dc:date>

<dc:source rdf:parseType="Resource">
<MVML:URI>
  <MVML:root>http://is-research.massey.ac.nz/verhaart/</MVML:root>
  <MVML:path>me_media/2004Finland</MVML:path>
</MVML:URI>
</dc:source>
```

<dc:subject> shows the three part pattern, the title (Subject), a default value (Finland, ICALT 2004) and a help prompt that would be used for automatic form generation.

```
<dc:subject>^Subject|Finland, ICALT 2004|Enter keywords separated with a
comma^</dc:subject>
<dc:rights>^Copyright| Copyright 2004 M H Verhaart. All Rights Reserved^</dc:rights>
<MVML:context>^Context|Finland Plane (Sat 21 Aug-Sun 22 Aug)Summer School(Mon 23-Aug-
Fri 27 Aug)/Conference (Mon 30 Aug - Wed 1 Sep)/ Technology Park(Thu 2 Sep),Plane(Fri 3 Sep-Sun
5 Sep) 2004|Describe the resource as if to a blind person^</MVML:context>
</rdf:Description>
<MVML:manifest>
</MVML:manifest>
<MVML:annotations>
</MVML:annotations>
</rdf:RDF>
```

Figure 8-16 : MVML template for image



### 8.8.6.2 MVML manifest media template

Since an MMO can be made up of many associated media files, a separate generic template for media was created, and this is included for each file when the MMO:MVML file is created.

Figure 8-17 shows a template model for images. Equivalent models have been created for text, animation, audio, video and application, and further extensions are possible (refer to Appendix B).

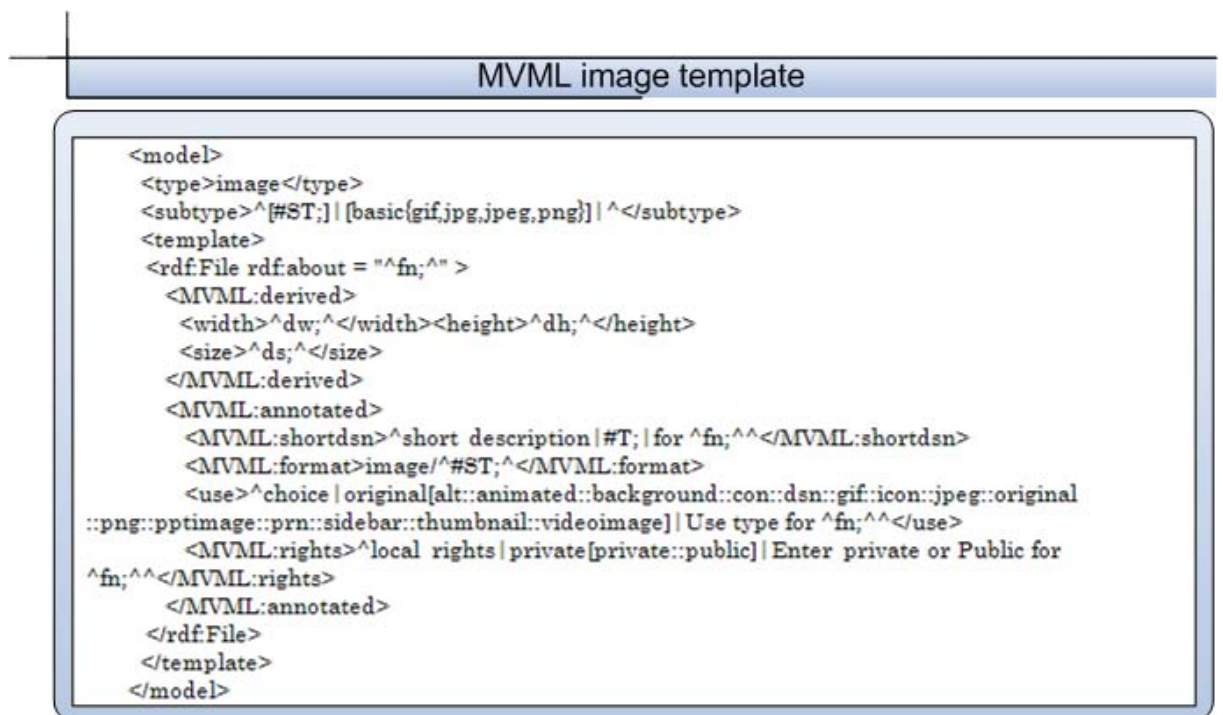


Figure 8-17: Image template for MVML manifest

#### 8.8.6.2.1 MVML template coding language

The coding language developed in this research allows an application to automatically fill in data and present a field on a form for the user to enter, and is described in detail in Appendix B. The coding commands are placed between the XML tags and always begin and end with a caret (^).

A derived value that can be entered by an application has a "&" prefix, so for example in Figure 8-16, the date is shown as



```
<dc:date>^&D^</dc:date>
```

A three part coding system is used to enter user annotated data, where each part is separated using the "|" character. The first part is the field label that may have attached to it a bracketed list of choices or an indication that this field is mandatory. For example, the title field is mandatory so this is indicated using "[\*]".

```
<dc:title>^Title[*] | ^</dc:title>
```

An example of providing a choice option is shown in Figure 8-17, where the use of the image is identified. The default value is first (original) followed by the choices (alt, animated, etc). Note that ^fn;^ is used to display the filename of the media file being coded.

```
<use>^choice | original[alt::animated::background::con::dsn::gif::icon::jpeg::origi  
nal::png::pptimage::prn::sidebar::thumbnail::videoimage] | Use type for  
^fn;^^</use>
```

The second part of the coding system contains a default value. For example, the subject field in Figure 8-16 automatically enters "Finland and ICALT 2004".

```
<dc:subject>^Subject | Finland, ICALT 2004 | Enter keywords separated with a  
comma^</dc:subject>
```

The third and final part contains a help message. In the subject field above, this is shown as "Enter keywords separated with a comma".

Figure 8-18 illustrates how these fields could be presented on a data entry form.

MVML Template form

Date

Title (required)

Choice 

Original

alt  
animated  
background  
con  
dsn  
gif

Subject

Use type for 2004Verhaart\_Finland.jpg

Enter keywords separated with a comma

Figure 8-18: Sample of a data entry form for metadata values

Inherited data is where data that is entered is joined to form an additional field. Figure 8-19 is an excerpt from a template used to create a business card MMO.

MVML Template for business card

```

<MVML:creators>
  <dc:creator rdf:parseType="Resource">
    <vCard:FN>^[#F, #O|#G, #P]|| Name (Family,Other or First,Prefix)^</vCard:FN>
    <vCard:N rdf:parseType="Resource">
      <vCard:Family>^Family Name|#F|^</vCard:Family>
      <vCard:Given>^Given Name(s)|#G|^</vCard:Given>
      <vCard:Other>^Other Name(s)|#O|Name you normally use if different from
given^</vCard:Given>
      <vCard:Prefix>^Prefix|#P|Eg. Ms, Mr, Mrs, Dr^</vCard:Prefix>
    </vCard:N>
    ...
  </dc:creator>
</MVML:creators>

```

Figure 8-19 : MVML coding for inherited data

The "#" symbol in the middle section of the code indicates that the value entered may be used elsewhere in the template, for example:

```
<vCard:Family>^Family Name|#F|^</vCard:Family>
```

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In this example the family name is reused in the full name field (FN), and this is shown by:

```
<vCard:FN>^[#F, #O|#G, #P]||Name (Last,Other or  
First,Prefix)^</vCard:FN>
```

Where #F is the family name, #O|#G is the other (given) name, or if it does not exist, the given name, and #P the Prefix, such as Mr., Mrs., Ms., Dr.

## 8.9 Developing software for the MMO

### 8.9.1 Creating an MMO with an MVML file for an image

To show how an application to create an MMO could be implemented, Figure 8-20 illustrates the process for an image file.

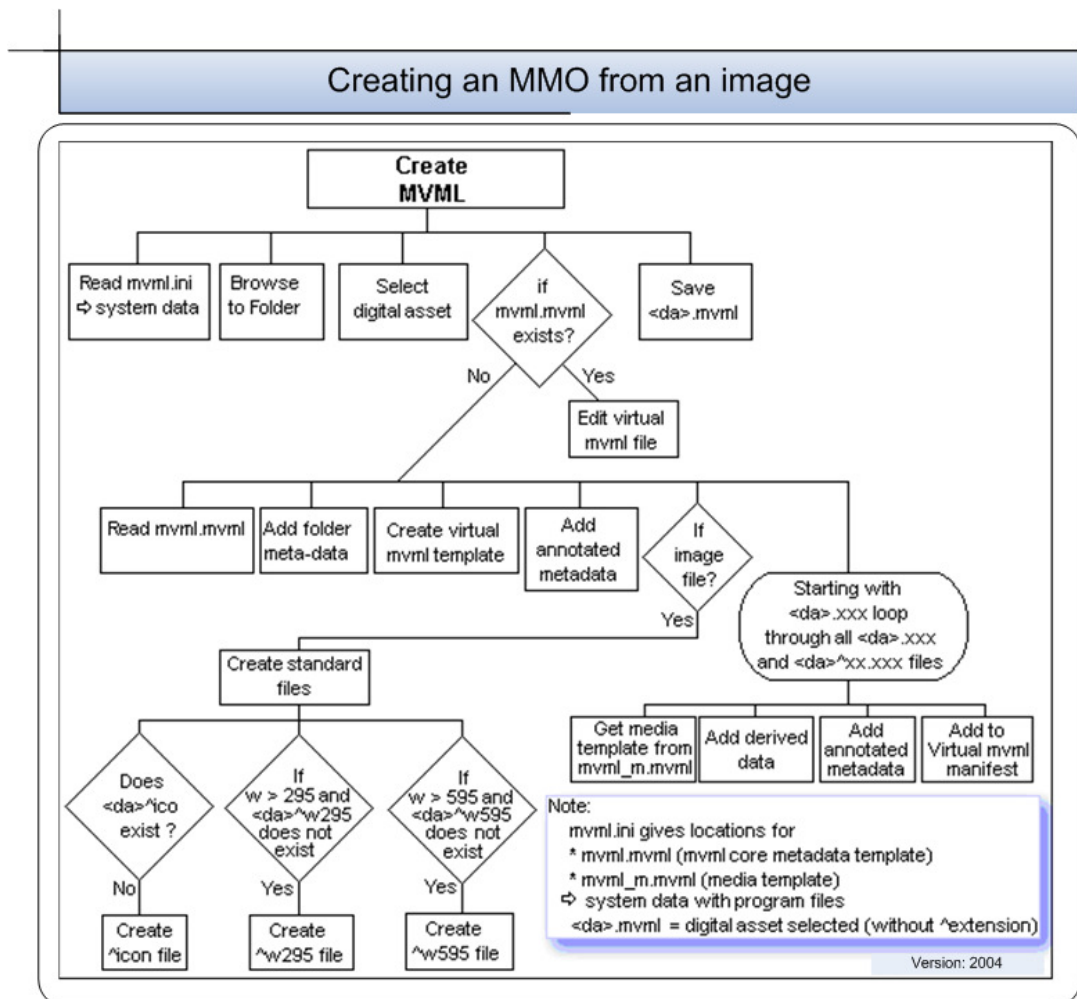


Figure 8-20 : Process for creating a Multimedia Object (MMO)

It will be observed that for an image file the MMO would contain:

- 1 MVML file
- 2 original image
- 3 ^ = icon (maximum height or width = 94 pixels )
- 4 ^w295 = screen (console) based image (295 pixels wide)
- 5 ^w595 = printer (prn) based image (595 pixels wide)

## 8.10 Future directions

There are many opportunities to use MVML based MMOs and although much of the ground work has been achieved in defining a workable language and model, there is still a lot of work to be done. This includes continually reviewing metadata implementations, to assess whether they will be able to accommodate the requirements of the MVML based MMO, and this should lead to further refinements.

The ability of an MMO to encapsulate not only past media but potential future media was illustrated through the implementation of a YouTube MMO (Figure 8-10).. The YouTube videos are stored as Adobe Flash movies, so effectively adding the capability to handle YouTube videos gave the virtualMe prototype the capability to manage Adobe Flash files.

## 8.11 Conclusion

This chapter presented a model that has been used to describe digital assets in such a way that they can retain their original context, be used efficiently in search routines and be easily shared. The context is attached to the asset via an additional and related file, keeping the original digital asset intact and unaltered. As the file is separated from the objects in the manifest, this allows for current and future formats to be catered for. Objects can be represented in a variety of formats to allow the appropriate type to be delivered dependant on the context in which it is to be used.

Cognitive recall is greatly enhanced when multiple representations are presented. For example, an image and an audio clip greatly assist in recalling a contact. Our memories may be triggered in many ways, so multiple representations can greatly assist in reinforcing the acquisition knowledge. Different situations may require alternative representations, for example, a set of textual steps can be useful in recalling a process but a video of the process is more effective when learning the process.

The MMO can be used in a wide variety of Web based applications and indeed the basic structure would provide benefits wherever media elements are used on the Internet. Allowing annotations to be added to the object can assist at the meta-cognitive level, and indeed can provide a level of dialog when multiple users are accessing the digital asset.

The multimedia object (MMO) uses a markup vocabulary, MVML, to define a collection of related resource objects suitable for use by adaptive technologies. Further, the MMO:MVML model can be used as a knowledge manager, as context can be added as metadata to any resource object, and this will further allow context searching that is a goal of the Semantic Web.

In short the MVML provides for:

- a uniform structure to derive knowledge;
- device input and output independence;
- a self-documenting vocabulary;
- context enabled multimedia elements;
- versatility in usability; and is
- software independent.

Important considerations for the MVML structure were as follows: was it simple to generate, and were there real advantages that would encourage its adoption? In the first case using XML standards to define the structure and incorporating standards such as the Dublin Core, xCard and RDF allowed for simple generation and transportability among various systems. The ability to use the MMO:MVML structure will allow many of the advantages described in this chapter to be realised.

This concludes the design and implementation of the virtualMe framework and associated models. The following chapters will review usage of the prototype and discuss a user survey of the prototype to investigate the perceived usefulness of the framework.

## **9 Action research cycle three: The virtualMe survey**

### **9.1 Introduction**

As described in previous chapters, in order to assess the effectiveness of the virtualMe framework in a teaching and learning context, a working prototype was developed to deliver content at the researcher's tertiary institution. This chapter describes the virtualMe survey developed to evaluate the virtualMe prototype to ascertain the perceived usefulness and determine whether the ease of use had an impact on the responses.

The efficacy of the prototype was evaluated by asking potential lecturers and users to play with the prototype's functionality and provide feedback in the form of opinions and make suggestions on the 4 main areas of the framework, that is: overall framework; annotation framework; resource acquisition, management and sharing at source; and teaching and learning. Optionally, users were able to request certain additional features, which could be added to a *wish list*, and these could be considered for future implementation.

Two groups were considered suitable for surveying to assess the efficacy of the proposed framework:

- direct users, that is those using the system in an instructional mode; and
- indirect users or visitors who have viewed the system out of interest and provided an email address, and included students, peers and guests.

The “live” prototypes were used to deliver content in several courses. In order to manage the impact on students, and therefore their grades, alternative delivery modes were made available to students, and included

provision of hard copy content and/or alternative web-based systems. The prototypes were implemented in a way that had direct relevance in the courses taught, and enabled a learning through collaboration (social-constructivist) style of teaching and learning.

Evaluations were collected electronically from direct and indirect users. A wide cross-section of technically competent users and educators were targeted for the survey, as three distinct phases were required:

1. Before the prototype could be evaluated, some basic training was required. To assist, online tutorials were provided in three modes: as a PowerPoint overview, as a walk through that could be printed (refer to Appendix C), and as a video tutorial.
2. Users were required to explore the prototype.
3. Users were asked to complete the survey.

This triple requirement meant that respondents were asked for a significant time investment. Since the prototype was web based, competence in web technologies was necessary to enable responses to be from an informed perspective. Unfortunately, this time commitment would, and has limited the number of responses. Students who had used either the V/2-Online prototype and/or the virtualMe prototype were asked for their feedback. Those who had used the earlier prototype were asked to explore the current prototype prior to filling in the survey, whereas those students who had used the current prototype could fill out the survey directly. Questions to ensure that biases were identified were included, such as whether the student was in a current class, or whether the prototype's usability influenced the responses.

Based on the requirement that participants needed to be Web competent and either potential lecturers/teachers/practitioners who would find this research of interest, or students who had been (or could be) exposed to the research the following groups were considered as suitable candidates



- Students from the researcher's institute.
- Students from the University the researcher was enrolled in.
- Members from the Advanced Learning Technology Research Centre, Massey University, and students in any classes to which virtualMe would be presented. This allowed the survey to be tested in small closed environments.
- Colleagues from other institutions including members of the International Forum of Educational Technology and Society (IFETS) online discussion forum, which is a global network of educators and practitioners in distance education and electronic learning technologies.
- Academic staff from the researcher's employing institute.
- Other staff/students in the Polytechnic/Institute of Technology sector in New Zealand.

Participants were encouraged to complete the survey, which was completely voluntary and anonymous. Participants were given a code that allowed them access to the survey, and then they created a personalized and anonymous unique identifier, that allowed them to revisit the survey as often as they wish for as long as the survey remained open. In the case of students, the ability to be anonymous meant responses could not affect any outcomes in any of their courses.

The survey with comments and ethical approvals from the researcher's employing institute and the university the researcher was enrolled in are included in Appendix D.

## **9.2 The survey instrument**

Based on the Technology Acceptance Model (TAM) a series of questions were written with a comment identifying the relevancy and justification (Refer to Appendix D).

In order to simplify the task of learning the prototype, a walkthrough was created, as a written set of instructions, a video and a PowerPoint presentation, that would take a person through the main features of the framework.

A pilot study was undertaken using 11 colleagues and current students, and based on their feedback minor modifications were made. These mainly related to simplifying the instructions, for example, one of the respondents indicated that the statement *“It does take a little bit of time as I would like you to try out the system rather than just complete a survey, but I am hoping you will get a chance to try something a little different that relates to teaching and learning”*, was too vague and needed to *“Tell them how long, otherwise they could think they’ll be there for hours”*. One of the respondents also suggested an additional comment needed to be added to the citizen question to allow for those with dual citizenship. A further modification was made after the survey was released, as it was found that users wanting to fill in the survey could not locate the survey code (as many had erased the email) so this was included in the text on the first page of the survey.

Probably, the biggest concern raised was the length of time to complete the prototype walkthrough, testing and review cycle. This was estimated to be in excess of an hour for someone who had not used the prototype before, and this would be a significant barrier to soliciting responses. Indeed this proved to be the case when discussing the actual response rate.

### **9.2.1 Data collection**

Once the survey instrument and online survey forms were finalized a variety of user groups were approached, these included:

- A class (15) of post graduate students (written feedback was collected and was keyed into the online system)
- A variety of online user groups that included: students studying at post graduate level, lecturers at New Zealand Polytechnics,

colleagues of the researcher's supervisor, members of the IFETS discussion forum, and associates that made contact while the survey was active.

- Colleagues of the researcher's institute, conference delegates and seminar participants.
- Users who had registered with the prototype. An email was sent to 93 users of the virtualMe who had accessed the prototype in 2006 (113 unique users were identified, but 13 were removed as they were expired student emails, and 7 emails were returned as invalid email addresses). A second email mail-out was initiated approximately 4 weeks later to 133 users of the earlier (V/2-Online) prototype that is those who had created a user profile prior to 2006.

The survey was closed for analysis on the September 18, 2007 with a total 58 responses.

### **9.2.2 Issues, limitations and resolutions**

Some issues occurred during data collection. The server briefly went down just after the email to colleagues was sent. This was rectified quickly and it is believed to have caused a minimal impact.

It is possible that the students' opinions of the benefits of the framework could be influenced by the design of the prototype or their experiences with the technology. If the prototype is poorly designed, or respondents encountered technological problems (such as connection issues), then they may feel there are few benefits. This is an important component of the TAM model and questions about this were asked in the survey so that this could be taken into account.

Participants were asked to complete surveys online, though this meant that only those who were technically competent would complete the survey potentially skewing the results. As the prototype was designed for use in a blended environment (face-to-face and online) the potential users should be

technically competent. Further, the participants would be expected to have the necessary technological skills in order to effectively assess the prototype's functionality.

Teaching methods could impact on students' perception of the value of the framework, for example, poor teaching could lead to poor reviews, and the survey contained questions related to this.

### **Bias**

Questions in the survey were included that attempted to identify possible bias, such as whether a student was in a current class, or whether the prototype's usability influenced the responses. Issues that affected some of the responses included: the *"dated"* look and feel, the problem that *"some pages loaded slowly/took a while to load"*, and the need to *"to experience system more to give some of the answers"*. With regard to the responses being influenced by the lecturer, comments indicated this was not the case and indeed one response stated *"no probably the opposite to give honest responses"*. A question was asked how to address the issues, and many indicated the need for a *"cleaner layout, with a better navigational system"*.

Regarding the necessity to fill in the survey online, overwhelmingly the respondents indicated they were in favour.

### **9.2.3 Ethical Issues**

No ethical issues were perceived because participation in the survey was voluntary and responses anonymous. Questions were directed towards the functionality of virtualMe framework and any perceived learning advantages. Ethical approvals were obtained by both the researcher's Institute (EIT) and the University enrolled in (Massey) and are included in Appendix D.

Whilst some demographic information was collected, data was stored without any obvious identifier and would be presented to the public in an aggregated format. Comments identifying any individual were either hidden or edited, and specific names were removed.

### 9.3 Results

The survey instrument was designed to measure the ease of use and perceived usefulness of the virtualMe prototype that demonstrated the concepts of the framework. The survey based on the *Technology Acceptance Model* ("TAM"; Davis, 1989) explored the 4 main areas of the framework: overall framework; annotation framework; resource acquisition, management and sharing at source; and teaching and learning. In line with the literature review these have been grouped as *information and knowledge acquisition* (overall framework, and teaching and learning) and *mechanisms for acquisition, management and dissemination of information and knowledge* (resource acquisition, management and sharing at source, and annotation framework).

The survey was opened on October 19, 2006, and on the 11<sup>th</sup> March 2007 the state of the data was analysed and formed the basis for three peer reviewed conference papers (Verhaart, 2007; Verhaart & Kinshuk, 2007; Verhaart & Jamieson, 2007).

The analysis presented in this chapter is based on the data as at the 19<sup>th</sup> September 2007, though there were only a few responses added since the March dataset. The results of the survey are included in Appendix E.

#### 9.3.1 Sample size

The survey was divided into two parts: perceived usefulness, and ease of use. Within these parts the survey was further sub-divided into four areas: overall framework; annotation framework; resource acquisition, management and sharing at source; and teaching and learning.

Fifty-seven responses were received in the survey from a wide variety of information technology competent respondents. To determine whether the sample size was appropriate, and that the responses can be considered valid, a reliability analysis was conducted on the data, with Cronbach's alpha computed. A reliability coefficient of **.70** or higher is considered "acceptable" in most research situations (Nunnally (1978) cited in Santos, 1999; Cortina, 1993; UCLA, n.d.).

Table 9-1: Cronbach's Alpha for perceived usefulness

	<b>Cases</b>			<b>Cronbach's Alpha</b>	
<b>Perceived Usefulness</b>	<b>Valid</b>	<b>Excluded</b>	<b>Total</b>	<b>N Items</b>	<b>Alpha</b>
Overall Framework	48 (84.2%)	9 (15.8%)	57	9	.628
Annotations	51 (89.5%)	6 (10.5%)	57	12	.796
Resource	47 (82.5%)	10 (17.5%)	57	4	.656
Teaching and Learning	49 (86.0%)	8 (14.0%)	57	5	.649
Overall	44 (77.2%)	13 (22.8%)	57	30	<b>.847</b>

Table 9-2: Cronbach's Alpha for ease of use

	<b>Cases</b>			<b>Cronbach's Alpha</b>	
<b>Ease of Use</b>	<b>Valid</b>	<b>Excluded</b>	<b>Total</b>	<b>N Items</b>	<b>Alpha</b>
Overall Framework	46 (80.7%)	11 (19.3%)	57	4	.766
Annotations	43 (75.4%)	14 (24.6%)	57	4	.945
Resource	44 (77.2%)	13 (22.8%)	57	3	.898
Teaching and Learning	41 (71.9%)	16 (28.1%)	57	4	.826
Overall	39 (68.4%)	18 (31.6%)	57	15	<b>.875</b>

As can be seen from the analysis in Table 9-1 and Table 9-2, for overall perceived usefulness and ease of use Cronbach's Alpha is 0.847 and 0.875 respectively, and in all but 3 cases exceeds 0.70.

### 9.3.2 Demographic information

In order to assess the backgrounds of the respondent's demographic information was collected. As at the 19<sup>th</sup> September 2007, 57 responses were received and this represents a substantial investment in time as the three phases could be expected to take in excess of one hour, and this was confirmed though verbal feedback. The results were gathered from both local and international respondents, and from a wide cross section of the teaching and learning community.

From a total of 57 respondents: 41 indicated they were students, 13 educators, 5 visitors, 6 other, with 6 indicating they were in two or more of the categories. There was a good gender balance with 29 males making up 51% of the respondents and 26 females 46% (2 left this question blank). In terms of expertise, approximately 1 (1.8%) indicated novice, 2 (3.5%) ok, 11 (19.3%) confident, 26 (45.6%) proficient and 17 (29.8%) expert, which could be expected from respondents who would be prepared to complete a technology based survey, and this is illustrated in Figure 9-1.

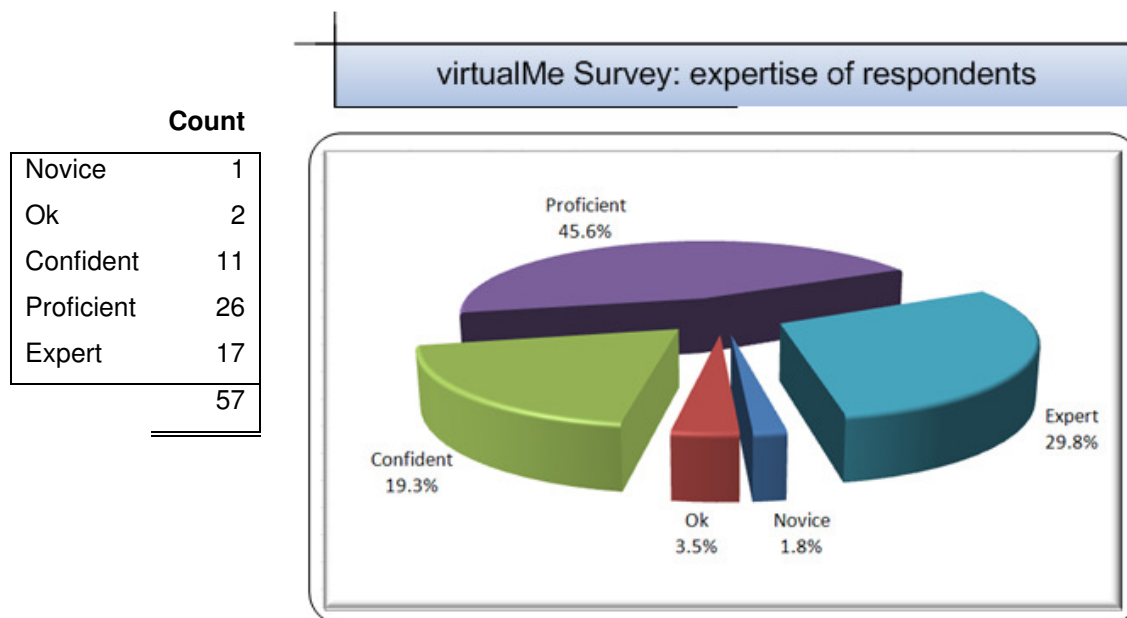


Figure 9-1: Survey: expertise of respondents

In the survey a reasonable spread of age ranges was achieved for potential users, as illustrated in Figure 9-2.

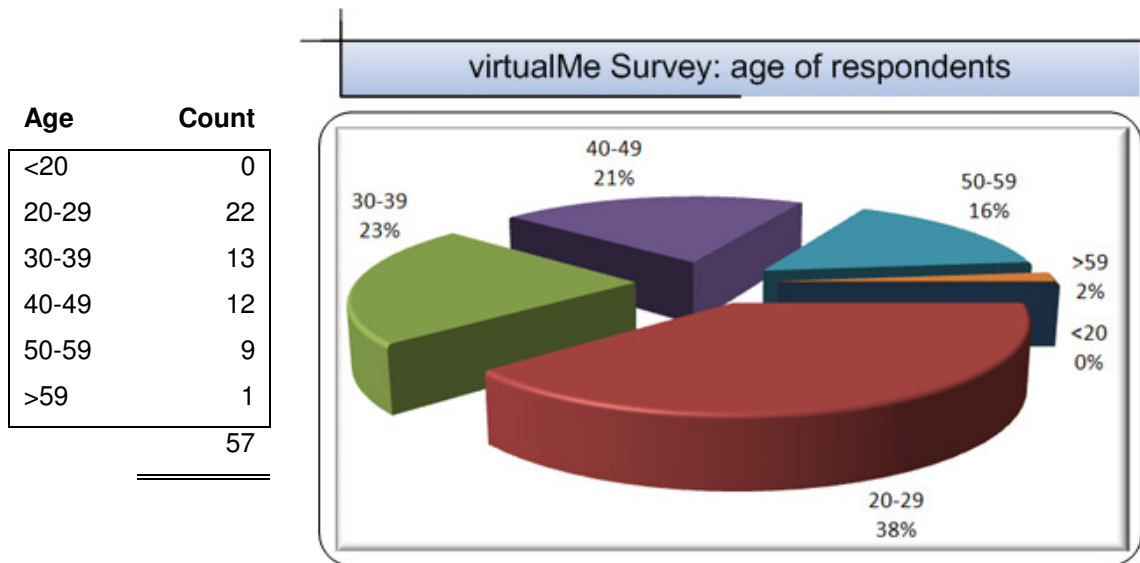


Figure 9-2: Survey: age range of respondents

While many respondents were in technology related domains, (e.g. information technology, information management, education technology, IT technician), there were also representatives across a broad range of other domains (e.g. marketing and management, English language, Maori education indigenous research, arts, health, legal business consultant, human job-based training and performance support). Forty-one of the 57 respondents (72%) indicated they had a personal web presence, with 17 having personal web sites, 13 on MSN Spaces and 11 blogging.

There is some necessary bias inherent in surveys related to technology, particularly those implemented in an online system, as the respondents require competency in the use of this technology in order to provide meaningful feedback. As the ubiquitous nature of the internet increases this bias will be reduced as the number of people who will have an understanding of this technology increases.



### **9.3.3 Analysis**

To evaluate the virtualMe framework, ease of use and perceived usefulness were measured. An ordinal Likert scale ranged from useless, not useful, useful, very useful and don't know, and respondents were able to skip any question (blank).

"Don't know" and blank responses were excluded from the analysis since they do not provide a measurable response either for or against the question posed.

Open ended questions were included after each section to provide participants an opportunity to elaborate on their responses, and these are included in Appendix E.

#### **9.3.3.1 Information and knowledge acquisition**

##### **9.3.3.1.1 *Overall framework***

This section dealt with structures for organizing the information and knowledge, and the snippet model.

##### **Perceived usefulness**

The virtualMe prototype demonstrated the features of the framework and Table 9-3 summarises the findings regarding perceived usefulness of the overall framework (count).

Table 9-3: Overall framework: Perceived Usefulness (Blank and don't know excluded)

	Useless	Not Useful	Useful	Very Useful	n	Useful + Very Useful
The ability to view content in a page layout is ...	0	1	18	33	52	51 (98%)
The ability to view content in a display (overhead) layout is ...	1	1	19	30	51	49 (96%)
The ability to combine content into a continuous view suitable for printing is ...	0	0	16	33	49	49 (100%)
The ability to include content in many places (e.g., a snippet describing the gif file format can appear in notes for web and multimedia) is ...	0	0	22	30	52	52 (100%)
The ability to customise your interface (Select icons, text or both, change the look, e.g., colours) is ...	0	7	23	21	51	44 (86%)
To have referencing information available on each page is ...	0	2	15	33	50	48 (96%)
The "feeling" that I am interacting with a person rather than content is ...	0	9	22	20	51	42 (82%)
The "feeling" that I am part of a network of users is ...	0	5	28	17	50	45 (90%)
One goal of virtualMe is to give the impression that you are conversing with an individual. To this end, the user interface can be changed, personalised images can be included, and messages from the lecturer can be sent. I find these personalisation features of virtualMe were useful to place the content in a context (i.e. gave the content meaning) is ...	1	5	18	24	48	42 (88%)

For the 7 out of the 9 questions, at least 44 (in excess of 90%) of respondents indicated the use of the features, such as snippet presentation and reusability, referencing information, and social structure were either useful or very useful. Only a few respondents indicated useless, not useful or having no opinion (don't know or blank). Interestingly the questions relating to providing a social context; that is interaction with the virtualMe rated lowest (42 or 82% rating this useful/very useful).

It can be observed from the results that the way in which content is presented is perceived as important. Providing referencing information was

generally perceived as being important and this probably reflects the teaching and learning focus of the respondents. Nine (18%) of the respondents felt it was not useful feeling that they were interacting with a person.

The ability to customize was low in relation to the other feedback, and this is consistent with research described by Bush and Tiwana (2005) where they found “that personalization only affects stickiness after the knowledge network has established itself”.

Reviewing the written comments some users felt it would be useful to create a messaging system so that users were aware of who was online and could initiate dialog. Comments were also made regarding the importance of the navigation system, including the breadcrumbs and were generally favourable. Providing the facility for a user to highlight sections would be useful and for annotations a hide/unhide capability. The main negative comments revolved around the amount of activity displayed, that is, the cognitive loading and some difficulty in understanding the navigation. Additional comments were generally positive regarding the overall prototype’s functionality and what it was attempting to achieve.

### **Ease of use**

Table 9-4 summarises responses relating to ease of use in the overall framework and in particular displaying content.

Table 9-4: Overall framework: Ease of Use

	Difficult	Not easy	Easy	Very easy	n	Easy + Very easy
Understanding the relationship between the menus, the snippets and the media elements was easy.	1	7	31	8	47	39
Viewing content did not require a lot of mental effort.	2	6	27	12	47	39
Understanding the difference between overhead view, page view and printout view was easy.	0	7	29	10	46	39
Viewing a media element in different ways was easy.	2	5	31	8	46	39

Encouragingly in all cases, 39 (in excess of 83%) of respondents felt that overall working with the content was easy or very easy, but with 7 to 8 (15% to 17%) finding it difficult or not easy, there is room for further development, and this was confirmed by some written comments from the respondents.

### **9.3.3.1.2 Teaching and Learning**

This section dealt with the issue of usefulness and usability in the environment in which the research was conducted.

#### **Perceived usefulness**

There were several features in the virtualMe prototype designed to be used in a blended (mixture of face-to-face and online) teaching and learning environment and Table 9-5 summarises responses from this perspective.

Table 9-5: Teaching and Learning responses (Blank and don't know excluded)

	Useless	Not Useful	Useful	Very Useful	n	Useful + Very Useful
Using virtualMe for my teaching/study would be ...	0	1	19	27	47	46
To improve performance in my teaching/study, using virtualMe could/would be ...	0	0	20	27	47	47
To improve productivity (save time, work, etc.) in my teaching/study, using virtualMe could/would be ...	1	4	18	23	46	41
To enhance effectiveness in my teaching/study (e.g., improves your capability of achieving the goal of delivering your course or getting your qualification), using virtualMe could/would be ...	0	1	21	24	46	45
If I had access to virtualMe in the future, I think would find it ...	0	3	17	26	46	43

From a teaching and learning perspective 46 (98%) of the respondents believed that virtualMe would be useful or very useful, with only 1 (2%) respondent indicating that using the virtualMe for teaching and study would not be useful. On the issue of whether using virtualMe would improve productivity, 5 (11%) of respondents felt that it would be useless or not useful. Using the prototype to deliver actual content to students, the researcher found that this indeed was the case, with a considerable effort required to build the MMOs and restructure courses into logical snippets. Indeed the user interface to add these features was not well developed since it was not something of concern to the users.

Several additional questions were asked in relation to teaching and learning. Respondents were asked to list features they found useful, and most of the features such as: the snippet, including its ability to be displayed in multiple ways, and reused in different context; MMO; annotation, including its ability to receive feedback from students (e.g. *"I like the idea of having the change to put comments on a page"*); personalisation; and the

ability to monitor student activity; were mentioned. Comments referred to the usefulness of the MMO with one respondent indicating “*the multimedia/text/annotation combination is very useful for aiding students in grasping difficult concepts*”. The use of video clips was also a feature many found useful.

In relation to features not considered useful, particularly related to the complexity, for example, “*the drill down depth is quite large*”, “*Some information not presented in easy flowing formats*” and “*I thought the pages had too many features*”. This is an area that would be useful for further research and indeed one of the responses indicated that “*I do believe the site does need upgrading to a more professional and cleaner looking environment. The more busy it gets the less appealing it is becoming*”.

### Ease of use

Responses were sought to validate that usability bias has been taken into account, in relation to ease of use and using as a training tool (including the use of training videos and teaching material), and are displayed in Table 9-6.

Table 9-6: Teaching and Learning ease of use responses

	Difficult	Not easy	Easy	Very easy	n	Easy + Very easy
Using the system was ...	0	3	27	9	39	36
Using the system to learn a new software application was/would be ...	0	3	28	7	38	35
Using the system to learn theory content was/would be ...	1	4	24	11	40	35
Using the system to display lecture material (using overhead view) was ...	0	3	18	18	39	36

Encouragingly at least 35 (87%-92%) of the respondents felt that the prototype was easy or very easy. Results from the survey indicate that

displaying content to learn theory would be an area that should be developed further in the future.

A written comment suggested that “*activities like exercises would be more useful to learn to do something practical, but snippets could be set up as activities (e.g. instructions to ‘do this’)*”. This has been implemented (e.g. HTML and XHTML) but the respondent could not have explored this area.

### **9.3.3.2 Mechanisms for acquisition, management and dissemination of information and knowledge**

#### **9.3.3.2.1 Resource acquisition, management and sharing at source**

This section dealt with managing the digital assets using a Multimedia Object (MMO).

#### **Perceived usefulness**

Table 9-7 displays the results of the survey with regard to perceived usefulness.

Table 9-7: Survey questions related to the MMO (Blank and don't know excluded)

	Useless	Not Useful	Useful	Very Useful	n	Useful + Very Useful
To have meta-data, referencing and digital rights information available for each media element is ...	1	2	22	23	48	45
The ability to drill down on each media element to see additional information is ...	0	3	18	26	47	44
To be able to display a media element in a variety of ways is ...	0	0	22	26	48	48
I would find the ability to copy a media object that contains contextual information such as author, ownership and a description ...	0	2	25	20	47	45

In relation to resource acquisition management and sharing, the ability to view a media element was perceived as useful or very useful, by at least 44 (94%) of respondents. The ability to view the element in a variety of ways (using an MMO) received a 100% response to useful (22 or 46%) and very useful (26 or 56%), and few written comments were added by respondents that elaborated their answer.

### **Ease of use**

Responses in relation to ease of use for resource acquisition, management and sharing at source are summarized in Table 9-8.

Table 9-8: Survey questions related to ease of use of MMO

	<b>Difficult</b>	<b>Not easy</b>	<b>Easy</b>	<b>Very easy</b>	<b>n</b>	<b>Easy + Very easy</b>
If I had access to a compatible system, the ability to copy a multimedia object (MMO) in my notes would be ...	0	4	728	7	39	35
Displaying reference information for a piece of content was ...	0	4	23	13	40	36
Displaying multiple representations for a piece of content was ...	0	3	27	9	39	36

In all cases at least 35 (90%) of respondents indicated that the implementation was easy or very easy to use, indicating that their responses to perceived usefulness were not influenced by the implementation. Few written comments were received regarding ease of use for the MMO.

### **9.3.3.2.2 Annotation framework**

This section deals with the acquisition of context focused information and knowledge.



## Perceived usefulness

The annotation framework was implemented in the prototype by allowing comments to be added to the content in and out of context. Table 9-9 displays results from the annotation framework questions where participants were asked to rate how useful they perceived it to be.

Table 9-9: Annotation framework (Blank and don't know excluded)

	Useless	Not Useful	Useful	Very Useful	n	Useful + Very Useful
The ability to target an annotation to a specific user is ...	0	1	22	26	49	48
Messages to/from the virtualMe are ...	0	3	23	25	51	48
Messages to/from everyone are ...	0	4	26	20	50	46
Messages to/from a specific individual (other than the virtualMe) are ...	0	1	27	21	49	48
Messages to yourself (reminders, side notes) are ...	0	2	19	30	51	49
The ability to annotate each snippet is ...	0	1	19	30	50	49
To be able to copy of a piece of content and make private changes (Wiki) is ...	0	0	26	24	50	50
Adding a comment to a specific media element such as an image is /would be ...	0	0	23	28	51	51
Annotations that are text based are ...	0	0	29	20	49	49
Annotations that are multimedia (images, audio, video) are ...	0	3	22	26	51	48
The ability to have content changed over time due to adding annotations is ...	0	1	14	36	51	50
Annotations generally are ...	1	2	24	23	50	47

Questions relating to the ability to annotate indicated that this was deemed important by at least 46 (92%-100%) of respondents. In the prototype 158 annotations were added, of which 51 were added by the owner of the virtualMe. With approximately 221 users registered in the prototype, and excluding the owner of the virtualMe, this equates to just less than 1 annotation for every 2 users with 55% of them being entered voluntarily.

Although values indicated that users perceived annotations to be useful or very useful, some of the written comments expressed reservations, for example, a comment from one of the respondents, *“For me, annotations of any kind seem to be useful but that's more from a research point of view. I cannot say whether and how often I would really use it also. But it's nice to have the option!”* An interesting observation was made by another respondent: *“I wonder how it will be kept 'cleaned up' though?”* which has also been brought up when the framework has been presented. Interestingly in the years that both the V/2-Online and virtualMe prototypes have been in use, there has been no inappropriate or spam type comments. From a usability point of view annotations can be “hidden” by the owner of the virtualMe should this be necessary and has been used where an annotation has become out of date (e.g. comments about the state of marking in an assessment) or entered in error twice.

## Ease of use

Table 9-10 displays a summary of the survey data as it relates to the ease of use of adding annotations.

Table 9-10: Annotation framework ease of use

	Difficult	Not easy	Easy	Very easy	n	Easy + Very easy
Adding annotations is ...	1	2	21	15	39	36
Adding out of context annotations (messages) is ...	2	4	22	8	36	30
Adding in context annotations (attaching an annotation to a snippet) is ...	1	2	25	9	37	34
Reviewing and replying to annotations is ...	1	3	24	11	39	35

As can be deduced from the data, apart from adding annotations out of context, at least 35 (in excess of 90%) of the respondents felt that adding an annotation was easy or very easy. Although, with 6 (17%) of the respondents

indicating that they found adding an out of context annotation difficult or not easy, this would need to be reviewed in any future development of the prototype. User comments did not highlight any obvious issues.

### 9.3.4 Further comments

The prototype was developed as a way to demonstrate the framework and models, and as such usability and design were important but not high on the list of functional specifications. This was expected to cause some bias in the survey results, but apart from a comment that the prototype ran slowly, the respondents gave positive results indicting ease of use. One of the respondents suggested *“After the technical work has been done, it might be good to get professional web designers to optimise the appearance of the site, especially if user-friendliness is an objective”*.

One of the respondents indicated *“I would like to see this developed into a [please pardon the term] commercial product, as it addresses some shortcomings that I see in the LMS products with which I am familiar (i.e., Blackboard, ANGEL, WebCT, Sakai)”*, and this too is an area for future research and development.

Enhancements to the existing prototype were on hold while the survey was in progress, so that the changes would not influence the responses.

## 9.4 Conclusion

Developing the survey instrument and seeking respondents proved to be a complex task. Past users proved to be the best source of participants and indeed for future research the collection of email addresses during the testing of any technology based system is an effective method.

Seeking feedback from discussion forums proved difficult and had a low response rate, particularly where a prototype had to be learnt prior to the

survey being completed. Future research into ways that responses for technology based projects could be improved would be useful.

This chapter also presented the results and findings of the survey.

Basic demographic data was collected from respondents and indicated a good gender balance (51% male, 46% female), had a balance of expertise that was appropriate for the research (19% confident, 46% proficient, 30% expert), and an appropriate age distribution of 83% between 20 and 50 years old.

The survey results provide some indicators that would benefit from further research. Interestingly for the overall framework, the ability to customize was low in relation to the other feedback, though this is consistent with research described by Bush and Tiwana (2005) where they found “that personalization only affects stickiness after the knowledge network has established itself”.

As expected in a prototype, the ease of use indicator varied between the different areas. For the overall framework, ease of use was assessed as easy or very easy by at least 83% of the respondents. For the annotation framework 17% of users experienced difficulty adding an annotation out of context (83% indicating easy or very easy) signalling an area for future investigation, rising to at least 92% indicating easy or very easy in response to adding an annotation, adding one in context and reviewing or replying. For resource acquisition, management and sharing at source at least 90% of respondents felt that using MMOs, displaying reference information and displaying multiple representations was easy or very easy. For teaching and learning apart from finding difficulties in learning theory from the prototype, 92% of respondents found using the prototype, using it to learn new software and using it to display lecture material was easy or very easy.

## **10 Action research cycle three: The virtualMe observations and reflections**

In this thesis a framework for a blended teaching environment allowing research into the acquisition of knowledge in context at source has been proposed. Successive prototypes were developed and the virtualMe framework evolved. Based on this framework a working prototype was implemented and tested to determine the efficacy of such a framework. This chapter consolidates the previous chapters which explored the design, implementation and an analysis of a survey of the virtualMe framework.

### **10.1 Information and knowledge acquisition**

#### **10.1.1 Content and context**

As the virtualMe is fundamentally an information and knowledge system the framework is centred on an individual, namely the instructor, and a requirement was the ability to acquire and organise the information and knowledge of the instructor.

A snippet was proposed as the core building block for the content and a model based on a physical overhead slide metaphor was developed. The prototype demonstrated that the snippet was feasible and with supporting structures, including a domain taxonomy, content could be managed. Further, information and knowledge do not exist solely as text so the capability to include multimedia in the snippet was important and this was explored. This research also found that an electronic object could easily lose context, and a multimedia object model (MMO) was proposed that managed the transfer of a media element while maintaining the context.

As stated by Meisenberger and Seiwald (2002, p.10), that “*most knowledge is socially derived*”, and the virtualMe framework explored the ability to manage an individual’s information and knowledge in a way that can be

contributed by and distributed to others. The use of annotations attached to the snippet content (in context), enables this to occur.

Does the framework manage the three knowledge types identified previously, namely: explicit, tacit, and missing? Explicit knowledge can be written down, and the framework uses the snippet and MMO to facilitate this. With regard to tacit knowledge, the framework could be considered assistive in that it can act as a prompt for tacit knowledge and can aid in the conversion of tacit to explicit. As the system is effectively a repository of information and knowledge it serves as a reminder mechanism and may trigger tacit knowledge recollection. For example, when used in lecture mode, the content can be used as the basis to discuss related issues, and the snippet format enables this to happen. The ability to identify missing knowledge is also an important feature, for example, students can identify that a particular piece of content lacks sufficient depth or is difficult to understand. This missing content can then be supplied by either the instructor or other users of the system.

### **10.1.2 Teaching and learning**

The virtualMe prototype has been used as a delivery mechanism over a two year period for several class groups, from diploma level (year 1 undergraduate) to years 1 to 3 undergraduate degree students.

A feature identified in the action research, and implemented in the virtualMe prototype was the ability to view snippets in OHT, page or print view. How did the provision of such a feature translate into practice? From August 2006 usage data was collected to ascertain how users chose to display snippets, and each time a snippet was viewed data was collected, including when they last accessed the snippet, and whether they viewed it in page, OHT or printer view. Excluding the virtualMe and guests, data was collected from 187 (of the 415 users), and this is summarized in Table 10-1 and illustrated in Figure 10-1.

Table 10-1: How users  
viewed snippets

Views	Count	%
Page	13,247	53
OHT	952	4
Print	10,749	43
	24,948	

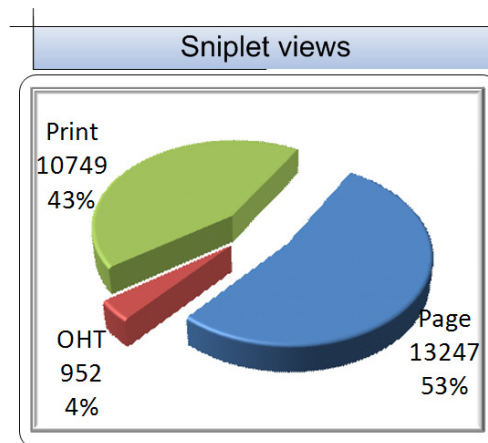


Figure 10-1: OHT, page and print snippet  
views

The researcher (virtualMe) and guests have been excluded from this analysis, since the virtualMe also used the site for testing, and the continuous printing capability for *guests* was disabled from August 2006.

For the guest account, page view was the default, yet the snippets were viewed in OHT view 2,782 times and page view 335 times (89% and 11% respectively). This is opposite to that of registered users and would be an area for future research.

It can be seen from Table 10-1, that almost the same number of snippets were viewed in page mode (53%) as in print mode (43%). Analysing the raw data further showed that each of the 187 individual users viewed on average 71 snippets in page display, 5 as OHTs and 58 in print view.

For the print view, 44 (24%) users chose this option, with the top 4 accounting for almost half (47.6%) of the snippets viewed in printing mode, and 9 users accounting for over 75%, and this is shown graphically in Figure 10-2. As expected (and unlike the guest data) OHT mode was seldom used since this is primarily used in a lecture to present the material to a group of students.

## virtualMe – snippets displayed in print view

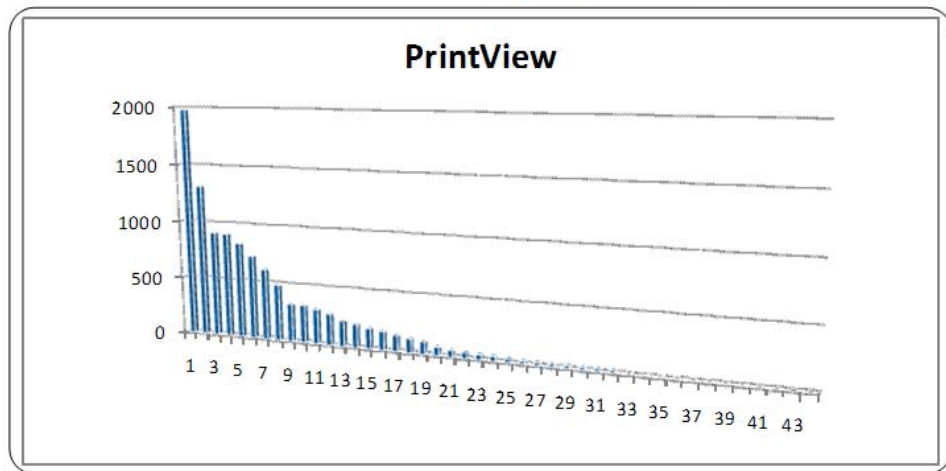


Figure 10-2: Snippets displayed in print view for top 44 users

It can therefore be deduced that most users were comfortable with reading snippets on a computer screen with a few requiring hardcopy of the material. Indeed the top two users of the printing option accounted for 39% of the printed snippets and had English as their second language.

To give a concept of usage and what potentially constitutes a successful snippet it is useful to consider which snippets were most popular. Table 10-2 shows the top 10 snippets sorted by the number of unique users that accessed it and the top 10 snippets sorted by the number of page views.



Table 10-2: Data showing the 10 most popular snippets by number of users and number of page views

Sort by No of users						Sort by Page view					
		LogCount			No. of Users			LogCount			No. of Users
	Snld	Page	OHP	Prn			Snld	Page	OHP	Prn	
1	485	92	5	9	47	1	664	93	7	22	37
2	658	84	10	22	41	2	485	92	5	9	47
3	35	58	7	28	41	3	659	92	10	22	37
4	223	72	15	11	39	4	662	92	12	22	32
5	424	50	3	22	39	5	660	90	13	22	33
6	587	44	1	41	38	6	658	84	10	22	41
7	664	93	7	22	37	7	666	74	0	22	28
8	659	92	10	22	37	8	223	72	15	11	39
9	556	56	3	39	36	9	663	72	9	22	32
10	557	54	1	39	36	10	2	64	3	7	29

Note: vMe and Guest accounts have not been included in the data.

Figure 10-3 displays screen captures of 4 snippets that feature in the top 10 in both lists. As would be expected a snippet describing Web mark-up languages (485) was the most popular as the students learnt HTML from the prototype. Students were required to develop a storyboard in both the Multimedia, and Internet and Web courses, so the storyboard related snippets (658 and 664) featured prominently. An experiment in creating a magic eye gif animation interestingly proved to be popular also, and this highlights the point that students will explore a system to find interesting information, which is consistent with constructivist learning.



The following observations can be made by reviewing the data and user comments in the survey in relation to principles 3, 5 and 7.

3. *Good practice uses active learning techniques.* The system provided content structured in a way to assist in learning new software (e.g. HTML, Adobe Director), and in order to be effective this needs to be easy to use. In the survey in answer to the question, “using the system to learn a new software application was/would be ...”, 35 out of 38 (92%) responses indicated the system was easy or very easy to use, indicating that the prototype was capable of providing active learning techniques. Written comments related to active learning techniques included: “*annotations (to promote constructivist learning mode)*”; “*the scope of using multimedia opens so many avenues for making courses interesting, resourceful and interactive*”; “*I think activities like exercises would be more useful to learn to do something practical, but snippets could be set up as activities (e.g. instructions to “do this”)*”; “*was an excellent way to deliver information for practical tutorials*” and “*this system was very effective teaching tool. It is self teaching and made me as a student become proactive*”.
5. *Good practice emphasizes time on task.* Chickering & Ehrmann, (1996) indicated that having content available online makes studying more efficient by allowing work and research to be done at home. The question “To improve productivity (save time, work, etc.) in my teaching/study, using virtualMe could/would be ...” was asked in the perceived usefulness section of the survey, and 41 out of 46 (89%) indicated this would be useful or very useful. A written comment supported this view: “*it’s great that you can assess your learning material from home via internet*”.
7. *Good practice respects diverse talents and ways of learning.* Chickering and Ehrmann (1996) identified that computer based technologies are capable of providing instruction using many different

methods. Written comments supported the capability of the system to facilitate this, for example: *“The multimedia/text/annotation combination is very useful for aiding students in grasping difficult concepts”*; and *“use of multimedia step-by-step guides for many procedures (e.g. animating gifs). Ability to alter display formats of information pages helpful if initial display format not suited to learning style”*.

## **10.2 Mechanisms for acquisition, management and dissemination of information and knowledge**

### **10.2.1 Content acquisition**

Does the framework support content acquisition? The framework proposed the snippet as the basic building block to manage the information and knowledge. Actual use of the prototype in a teaching and learning environment proved that the ability of the snippet model to acquire, manage and distribute information and knowledge. From the survey, in terms of the perceived usefulness of the features of the snippet, a significant number of users found the features to be useful or very useful. For example, the ability to: view content in page layout (51/52 or 98%); view content in a display (overhead) layout (49/51 or 96%); combine into a continuous view for printing (49/49 or 100%); and to include content in many places (52/52 or 100%).

### **10.2.2 Resource acquisition, management and sharing at source**

The research questions associated with resource acquisition attempt to identify the features that allow digital assets to *“retain context while transferring the content from one person to another and from one place to another”*, and for the multimedia object (MMO) model *“which features are*

*perceived to be useful by users*”? Analysis of features and user perceptions will be done in the evaluation of the data from the user survey in chapters that follow.

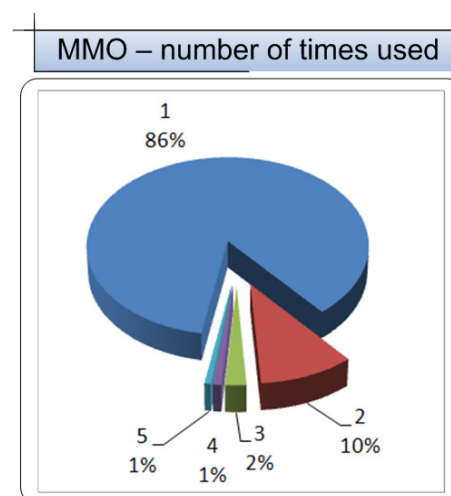
The MMO model was extensively used in the virtualMe prototype, and as at 6th December 2007, 832 MMO files had been created over the two years the prototype was developed and used. Over this period the templates were modified as the requirements evolved. The MMOs were able to be shared between snippets and multiple representations were able to be displayed in the same snippet.

In the prototype virtualMe database, 1,249 snippets were created, and 446 MMOs were added to snippets.

The question “*does the MMO facilitate object reuse?*” was asked during one of the workshops in which the framework was discussed. “To answer this, an analysis was done on the number of times an MMO was attached to a snippet. Table 10-3 displays the statistics based on the usage data. Of the 446 MMOs, 14% (62/446) were used more than once, with some used up to 5 times in the prototype.

Table 10-3: Data for multimedia object, showing the number of times each MMO was used

Number of times the MMO was used	Number of MMOs
1	384
2	45
3	10
4	4
5	3
	446



### 10.2.3 Annotations

Research into annotations was conducted in two parts: firstly through user interaction with two of the prototypes, and secondly via a survey. Unfortunately, during the initial trials a software modification occurred that prevented the annotations being added, and was at a critical time when students were asked to enter mandatory annotations, so this had an effect on the data gathered.

Two research questions were considered in relation to the annotation framework:

*What features are desirable in a framework that would enable other people to add information and knowledge that will benefit all users of the system?”, and*

*In the virtualMe which annotation features are perceived to be useful?*

In determining what features are desirable it is useful to consider the ways in which the prototype was used as an annotation tool and the types of annotations created by users.

As in the V/2-Online prototype, students in an Internet and Web design course were required to create an annotation as part of an assessment. Although all of the domains in virtualMe are integrated the annotations were divided into those entered for Internet and Web design (mandatory) prior to September 3, 2006 (the date of the assessment) and the others.

#### 10.2.3.1 Analysis of Annotation data

Annotations were coded according to type, and these are listed in Table 10-4. To provide a comparison, annotations for the V/2-Online prototype are listed with the virtualMe prototype, and combined to give an overall view of the types of annotations added to the system. As the “Internet and Web

Design” course required students to add an annotation these are separated from the annotations added voluntarily by users.

Table 10-4: Data for optional and mandatory annotations for V/2-Online and virtualMe

Code	Type	V/2-Online		virtualMe (2006)		Combined			
		M-media Optional	Internet Mandatory	Others Optional	Internet Mandatory	Optional		Internet Mandatory	
CC	Correction/Mod in Context	6	9	6	5	12	11%	14	10%
CX	Correction/Mod out of Context	0	0	5	8	5	5%	8	6%
IC	Information in Context	4	15	13	1	17	15%	16	12%
IX	Information out of context	2	8	11	4	13	12%	12	9%
KC	Knowledge in Context	3	12	16	30	19	17%	42	31%
KX	Knowledge out of Context	0	0	1	16	1	1%	16	12%
QC	Question in context	0	7	0	0	0	0%	7	5%
QX	Question out of Context	1	3	5	3	6	5%	6	4%
SC	Social in Context	0	0	2	1	2	2%	1	1%
SX	Social out of context	1	2	10	0	11	10%	2	1%
O	Other (Note, comment, ...)	5	10	18	3	23	21%	13	9%
RF	Reference	2	0	0	0	2	2%	0	0%
<b>Total</b>		<b>24</b>	<b>66</b>	<b>87</b>	<b>71</b>	<b>111</b>		<b>137</b>	
				<b>Total virtualMe = 158</b>		<b>Total combined = 248</b>			
<b>Distinct Users</b>		<b>68</b>	<b>84</b>						

Graphically the combined percentage values can be represented as shown in Figure 10-4.

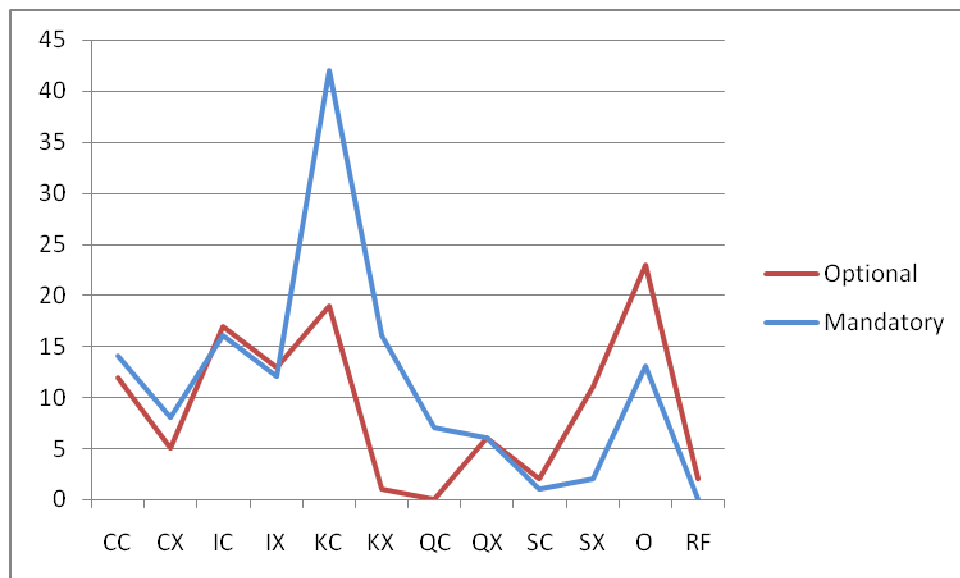


Figure 10-4: Comparison of annotations as part of an Assessment (mandatory) and entered voluntarily (optional)

It can be seen that knowledge in context (KC) is the most frequent use of the annotation system particularly when annotations are mandatory, and if “other” (O) is ignored then information in context (IC) is the next most frequent followed by knowledge out of context and information out of context. So the ability to add information and knowledge should be an important feature to be considered when implementing an annotation system.

Can this annotation data be related back to Chickering and Ehrmann’s (1996) “seven principles of good practice”? In the virtualMe framework, annotations can relate to principles 1, 2 and 4, and in the survey there was feedback to this effect.

1. *Good practice encourages contacts between students and faculty.*

Through annotations students could communicate with both faculty and other students in the virtualMe prototype. Analysing the annotation data it was seen that only 8 out of 158 (5%) of the annotations were questions, and the majority of these were in context. In a previous study on V/2-Online this was 11 out of 90 (12%) (Verhaart & Kinshuk, 2005b). So, although the prototypes allowed students and visitors to seek assistance, this feature was not used extensively. This is not surprising as the classes were a mixture of face-to-face and online so students could ask questions in class, or via email, as well as through the system.

2. *Good practice develops reciprocity and cooperation among students.*

While the prototype allowed for discussion using annotations, in practice this was not used to facilitate discussion. Based on the annotation data collected, from the 221 students and visitors 158 annotations were entered into the virtualMe, even though there were problems with the first iteration from Semester 1, 2006. For the virtualMe 87 out of 158 (55%) of the annotations were optional, and 136 of the 248 (55%) annotations overall were sharing information



and knowledge (Table 10-4). Of the 158 virtualMe annotations, 51 were added by the owner of the virtualMe, so excluding the owner of the virtualMe this equates to almost 1 annotation for every 2 users with over half (55%) of them being entered voluntarily by users.

4. *Good practice gives prompt feedback.* The prototype allowed students to annotate content in a contextual way, and as annotations are aggregated into a summary display (unlike those in V/2-Online) those requiring feedback could be quickly determined.

The importance of a feedback loop was highlighted in a student comment received independent of the survey relating to annotating a snippet which stated: *“The worry with this type of annotation is that no-one is obliged to pay any attention to it. There seems to be no feedback loop to it to ensure that any suggestions made or links suggested are followed up on. It just seems to fall into the trap of being forgettable post-it notes.”* The implementation of a feedback mechanism such as, an email to the virtualMe saying an annotation has been added (as is typical of a bulletin board), or a track on how many times the annotation (or its link) was viewed, or the inclusion of a request reply check-box could facilitate a better feedback loop and would be an area for further research. This is consistent with the observations of Graham et al. (2001) indicating that for online teaching good practice *“instructors need to provide two types of feedback: information feedback and acknowledgment feedback”*.

To consider a third question *“What factors influence the quality and quantity of annotations?”*, some students commented that the annotation they wished to add did not have a logical snippet to attach it to, and so placed them on the first page of the domain content. A mechanism to manage this in an area for further research.

## 10.2.4 Learning/Content management systems

How does the virtualMe compare to existing learning/content management systems?

Kilfoye (2008) quoted a recent Eduventures survey of more than 550 two-year and four-year colleges showing Moodle with about 7.8 percent of the market, Blackboard at 66.3 percent market share. Proprietary Learning Management System (LMS) vendor Angel (4.1%) was followed by Desire2Learn (3.2%), Sakai (2.5%), e-College (1.6%), and others.

While it would be desirable to compare Blackboard, access to the functionality requires access to a Blackboard system which carries a substantial cost (US\$5000/server to US\$50,000/server (Änderung, 2008)).

Moodle has over half a million registered users, speaking over 75 languages in 193 countries (Moodle, n.d.) with significant users as *Athabasca University in Canada, UK's Open University and San Francisco State University* (eLearnz, 2006b). As at October 10, 2008, in New Zealand 242 sites were registered (<http://moodle.org/sites/index.php?country=NZ>).

In 2004 the New Zealand Ministry of Education released an “Interim Tertiary e-Learning Framework” and stated that *"Interoperability standards are required in order to develop the networked education system described in the e-learning vision – an environment in which digital tools and resources can be accessed and shared across the whole system"* (New Zealand Ministry of Education, 2004, p.13). Projects based on this framework include: the *Open Source Courseware Initiative New Zealand (OSCINZ)* (eLearnz, 2006a) and *Open source e-Learning Environment and Community Platform* (eLearnz, 2006b) have adopted Moodle as the managed learning environment (MLE) of choice.

As stated by Chavan and Pavri (2004) *“most Learning Management Systems are instructor-oriented and largely concerned with how course content is*

delivered. Moodle is based on a learner-oriented philosophy called *social constructionist pedagogy*, in which students are involved in constructing their own knowledge”, and hence it is appropriate to compare the virtualMe framework. A Moodle course showing the resource and activity options is displayed in Figure 10-5, and the book resource that uses a book metaphor to create content viewable online or that can be produced in a printable format is displayed in Figure 10-6.

In 2006 the researcher’s employing institution changed from Blackboard to Moodle, and from prior experience the author of this thesis concurs with Chavan and Pavri (2004) that Blackboard is instructor-oriented and largely concerned with how course content is delivered. As Moodle is a system that was (and is) available, and is based on social constructivist pedagogy (Moodle docs, 2008; Chavan & Pavri, 2004) an appropriate comparison can be made between Moodle and virtualMe.

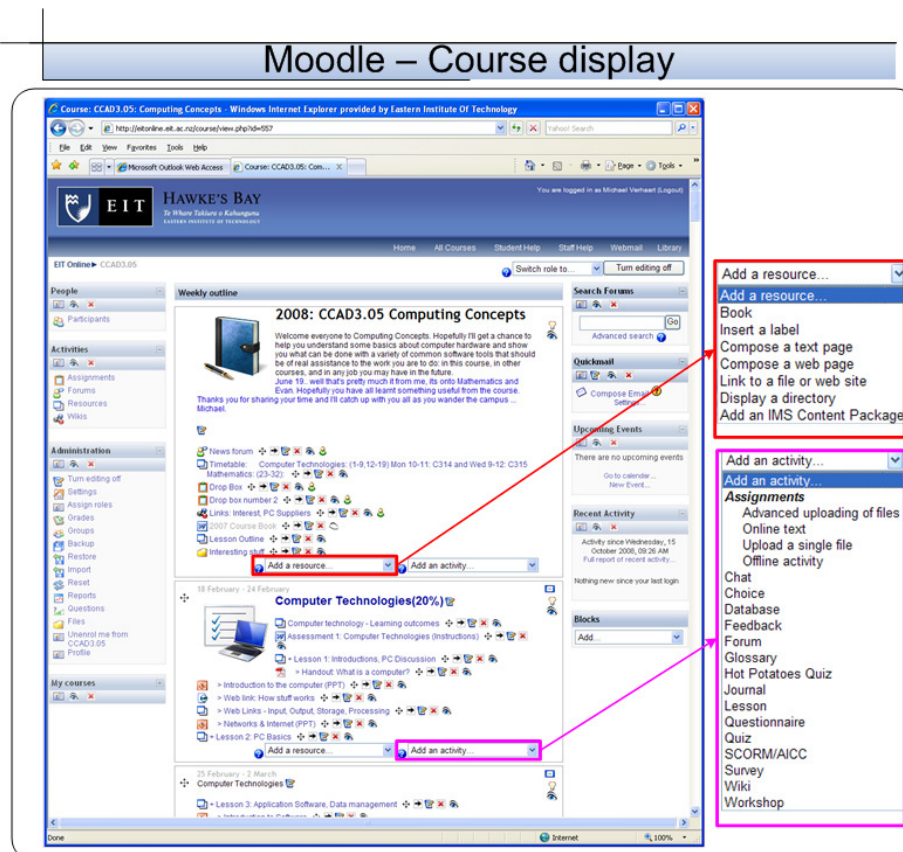


Figure 10-5: Course displayed in Moodle

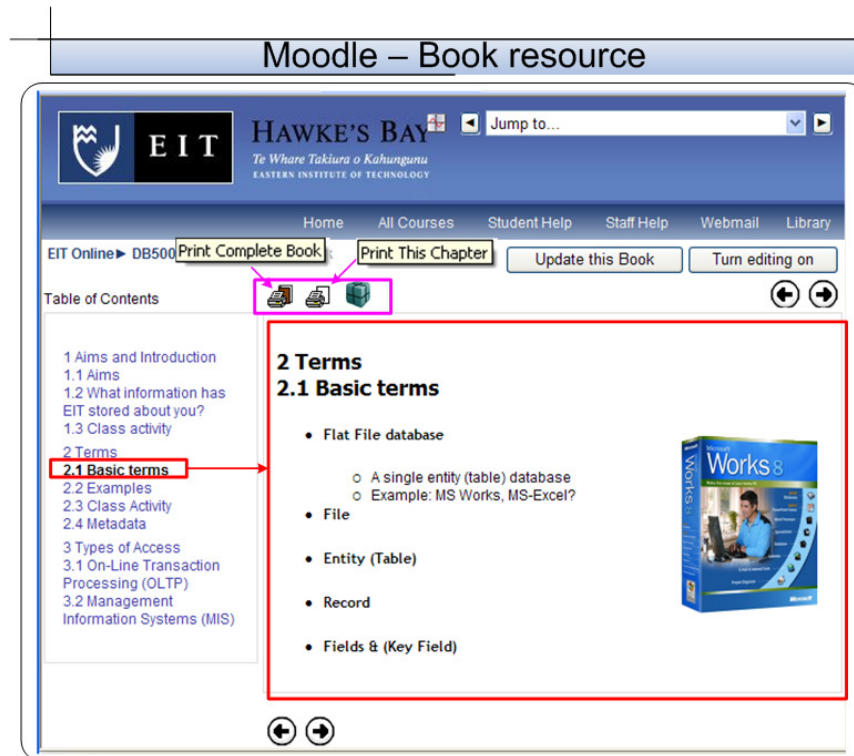


Figure 10-6: Moodle book resource

Probably the most significant collaborative content management system would be Wikipedia. Powered by Media Wiki (MediaWiki, n.d.), Wikipedia by 2008 attracted more than 684 million visitors, with 75,000 active contributors and more than 10 million articles in over 250 languages, with just over 2.5 million in English (Wikipedia, 2008c). To allow the virtualMe prototype to be compared, some content from the virtualMe prototype was converted into MediaWiki, and is illustrated in Figure 10-7.

## MediaWiki – Content example

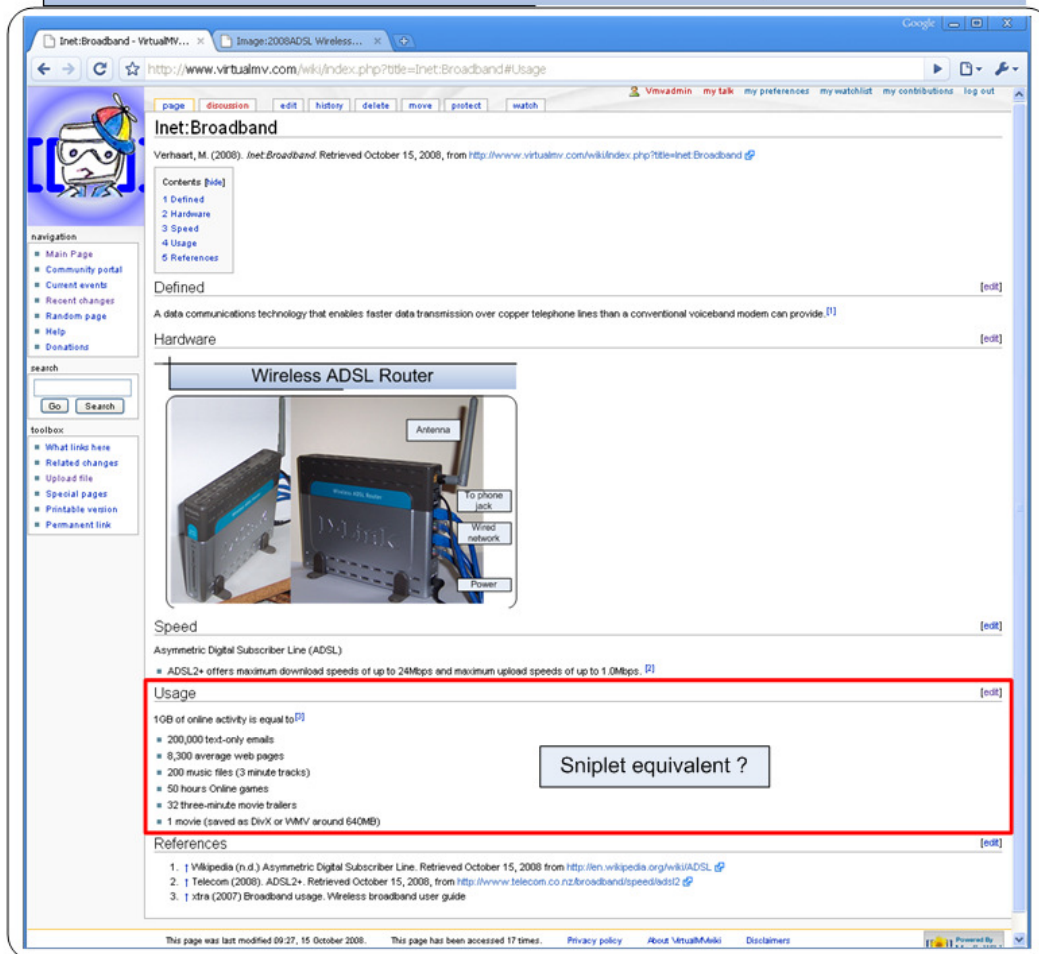


































Figure 10-7: Content displayed in MediaWiki























In the previous chapters the virtualMe framework and prototype were described. The following table compares the features of the virtualMe framework to the capabilities of Moodle and MediaWiki.

Table 10-5: virtualMe features compared to Moodle and MediaWiki









Information and knowledge acquisition	
Key:  = Moodle,  = MediaWiki	
	<b>Acquisition (Explicit, Tacit, Missing)</b>
virtualMe	Able to manage explicit knowledge (as a snippet), facilitate tacit (present content for teacher support) and provide an annotation capability for others to either add or indicate missing knowledge.
	Many disjointed sub-systems are available, that may be linked through email. Missing knowledge can be handled through a wiki or bulletin board.
	Explicit knowledge easily managed, tacit knowledge can be explicated and missing knowledge can be added by users directly into the content (and changes are tracked).
virtualMe	Chunks need to be “contextualized” and annotated in their context.
	Content arranged as resources in a course. Some resources allow annotation (e.g. wiki, bulletin boards), but no integrated annotation possible.
	Organised as hyperlinked pages, annotations are changes made to actual content.
virtualMe	Acquiring context focused information and knowledge from users (annotation framework).
	No in-context annotation. Bulletin board and wiki allow some level of in-context annotation, but no integrated annotation facility.
	Annotation is by actually changing/ adding to the content.
virtualMe	Integrated references management.
	Not available.
	Able to include reference citations in the text with a MediaWiki add-in.
virtualMe	Content can be attached to multiple domains.
	Course based content, requiring duplication.
	Hyperlinking allows networked content.
	<b>Context</b>
virtualMe	Content placed in context domains (e.g. Multimedia) with overall taxonomy.
	Content generally placed in subject/course domains. Duplication of resources. A book resource is available (Figure 10-6) that allows content to be created for a domain.
	Free form, possible to create overall taxonomy, but can be hierarchical or networked (as hyperlinked).
	<b>Pedagogical considerations</b>
virtualMe	Integrated teaching delivery (Overhead, notes, and publication views). Content displayable on an Overhead Projector (OHP), in a notes view and consolidated for hard copy version.
	Many sub-systems available, including ability to include digital assets such as PowerPoints, PDF files, Quizzes, etc. Generally stand-a-lone and not integrated. A book resource is available (Figure 10-6) that allows for content to be produced as an online book and provides a printable consolidation, though no annotation capability.
	Publication view format (consolidate notes). No presentation mode (can increase the font size, but does not summarise content).

<b>Mechanisms for acquisition, management and dissemination of information and knowledge</b>	
	<b>Acquisition</b>
virtualMe	Content stored in small chunk (Sniplet).
	Content can be included in a course in many ways: As a book; a label; a text or web page; or a link to a file, web site, or directory. The web page display allows some media elements (e.g. images) to be included. (Figure 10-5).
	Content is stored as a page. The page can be broken up into sections using a heading break. A section could be considered to be a snippet equivalent (Figure 10-7). Limited media display is available, and basic multiple representation using a thumbnail linking to a full sized image.
virtualMe	Content can be associated with multiple multimedia elements.
	Based on a course structure, can have many media types. At a content level primarily images attached.
	Primarily images, though the use of HTML code possible to insert other media types.
	<b>Resource acquisition, management and sharing at source (MMO)</b>
virtualMe	Capability to manage media resources and multiple representations.
	Media managed in a folder attached to each course. No multiple representations.
	Media stored in a common folder. Attaches basic metadata (Date/Time, User, Dimensions, File size and a comment). Can have thumbnail link to higher resolution images. Minimal number of file types set up. Flash requires a third party add-in.
virtualMe	Capability to have multiple representations of a media asset.
	Not included.
	Not included.
virtualMe	Capable of displaying multimedia files.
	Supports a wide variety of multimedia file type in the many sub-systems.
	A restricted number of associated media file types are possible. Additional file types need to be explicitly set up. Flash (such as YouTube inclusions) need third party software add-ins.
virtualMe	Supports a wide variety of multimedia.
	Multimedia support varies. Images well supported. Other media files (e.g. Video, PowerPoint, PDF, Doc) files loaded into folder and linked, Flash files not inbuilt but can be embedded using inserted code ( <a href="http://davecormier.com/edblog/2007/04/02/embedding-flash-into-moodle-or-whatever/">http://davecormier.com/edblog/2007/04/02/embedding-flash-into-moodle-or-whatever/</a> , October 16, 2008).
	Images mainly supported. Other files linked to and may be uploaded into a web accessible folder. Flash can be supported as for Moodle.
	<b>Annotations</b>
virtualMe	Interaction with the system for visitors is by annotating in context.
	No in-context annotation.
	Annotation is by actually changing/ adding to the content.
virtualMe	Consolidate user annotations.
	Additions to bulletin boards can be emailed to users.
	Annotations are made directly in content.



virtualMe	A global comment can be created to notify all users before logging in.
	As institutional this is possible by system administrator. Course comments can be added at the top of the course page (Figure 10-5).
	Can be added as a comment on the first page.
virtualMe	Annotations can be added that are public, directed or personal to the system (global) by the owner (vMe) or visitors.
	Bulletin board comments. Also some instant messaging possible. But out of context (unless a bulletin board is used).
	Only by editing/ adding to content.
virtualMe	Annotations can be added in-context to content, or can be added to an existing annotation (a thread).
	Limited availability in the bulletin board activity.
	Not available.
virtualMe	Users can modify content (in wiki mode).
	Possible using wiki resource – but not integrated.
	Main feature of MediaWiki.
virtualMe	Annotations can be added to media.
	When including media into a course alt text can be added images. Note this is added when media is inserted into the course, and not attached to the files on upload. No annotations possible.
	Media is uploaded with a comment. No annotations possible.
	<b>Personal Content Management</b>
virtualMe	Personal data, information and knowledge need to be added in a controlled and consistent way.
	Able to be added in a multitude of ways, books, text/web pages, links (Figure 10-5) but disjointed.
	Basic structure of hyperlinked pages.
virtualMe	A user interface which: reflects the personality of the owner of the system (customisable and adaptable); and be user adaptable.
	Based around an organisation rather than an individual. Some customisation of a course possible using “corporate” templates. Restricted user customisation.
	Some customisation using templates possible. Not user customisable.
virtualMe	Able to manage own knowledge (as snippet).
	Designed to facilitate learning management and delivery rather than personal knowledge management.
	Anyone is able to change content basically making this a shared repository rather than a personal repository that others interact with.
	<b>Learning/Content Management</b>
virtualMe	Benefits in a teaching and learning environment, including functionality to be: a teaching delivery mechanism; a self study (online or offline) assistant; and used to display material for discussion on a data projector.
	Comprehensive set of tools, but are disjointed: e.g. PowerPoint used to present, Book for content.
	Can be used as a content repository. Enlarge font in browser can be used for overhead, but not summarised.
virtualMe	Able to convey a sense of “interacting with a person” in a “community”.
	Many (disjointed) tools available to create community. Can be linked together by email to users.
	Not available.
virtualMe	Managing and tracking user details.
	Some user tracking available. Example, when last logged in.
	Only if a user logs in and adds some content.
virtualMe	Able to view content as an overhead.



	No explicit technique, can use web browser properties to enlarge text sizes. Book resource displays chapters which could be organised as snippets. No annotation capability.
	No explicit technique, can use web browser properties to enlarge text sizes. No annotation capability, but can change actual content.
virtualMe	Able to view content in a notes format.
	No integrated way. Book resource provides one way this can be managed.
	This is the way a wiki displays the content.
virtualMe	Able to consolidate content into a printed format.
	Book structure available (able to print chapters).
	Content structured in page view with separate blocks (similar to V2-Online).
virtualMe	Access needs to be by: person, visitors (students, registered visitors - such as family, friends and possibly other people unknown to the person), and guests.
	Extensive user management allowing administrator, guest or restricted access.
	Generally open access but can set up so that changes can only be made if a user logs in.

The comparisons show that the biggest difference between Moodle and virtualMe is the integration of the content management, and the absence of an annotation system. For WikiMedia, the structure is similar to V2-Online, but lacks multiple display capability and as for Moodle annotation capability. Moodle is centred on Institutional needs, MediaWiki on community collaboration, whereas virtualMe is centred on an individual with the user community able to add annotations.

## 10.3 Observations from usage data and the development log

### 10.3.1 Usage data

The research questions for the overall virtualMe framework relate to features and functionality and as such were addressed through developing prototypes and through the user survey. In this section, the prototypes usage data is reviewed as it provides a useful background to the responses of survey participants.

During 2006, the virtualMe prototype was hosted on two separate servers, partially to allow for redundancy should a problem occur with either server,

and partly to address performance issues as one of the servers was hosted off shore. Over the trial period 2006-2007 actual usage statistics were tracked by the United States hosting server (<http://www.brinkster.com>), and are shown in Figure 10-8. The local server was decommissioned early in 2007.

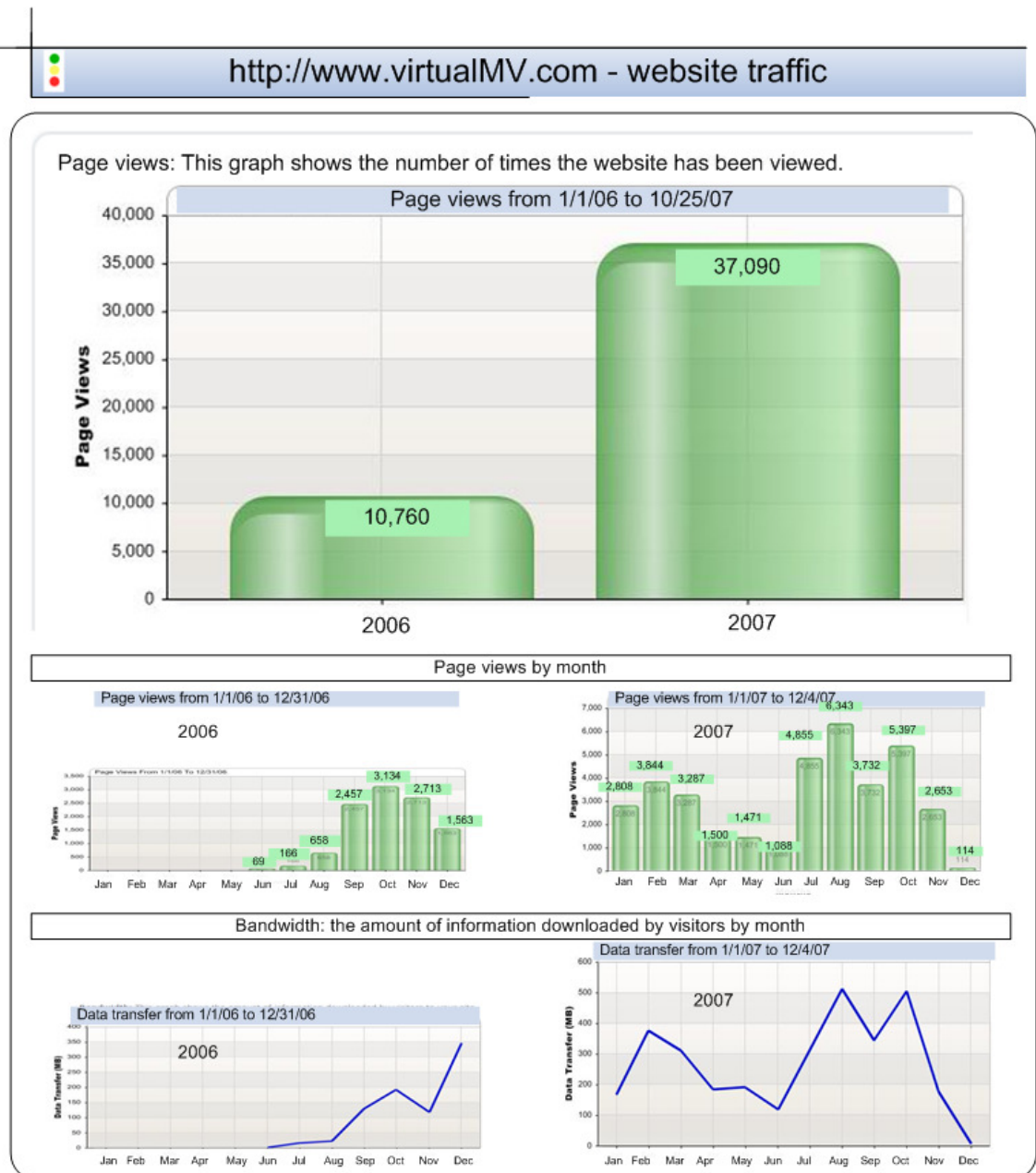


Figure 10-8: virtualMV website statistics (2006-2007)

As courses are semester based the page views can be further summarized as shown in Table 10-6.

Table 10-6: Semester based page views of the virtualMe

	2006	2007	
Semester	2	1	2
Page Views	10,691	13,998	23,092
Increase over previous semester	-	24%	40%

Semesters started in February and July. In semester 1, a multimedia course was taught using the prototype and in semester 2, an Internet and Web course was taught. Difficulties experienced by students in accessing the prototype in 2006 hampered the usage, but as can be observed from the data, the prototype was extensively used.

#### 10.3.1.1 User profile analysis

Both the V/2-Online and virtualMe prototypes shared the same user table, so that, as the virtualMe evolved, both prototypes were accessed with the same user identifier and password. Up until December 6, 2007 the number of unique user profiles created for both V/2-Online and virtualMe was 496. However, an issue arose in both prototypes regarding users forgetting their passwords. It turned out that users found it easier to recreate a new user account rather than recalling their password. Subsequently, the 496 user records were reduced to 417 after test records (11) and duplicate records (68) were removed by comparing user names, last names and email accounts. Fifty-three users (or approximately 13%) were identified as having more than one user profile, with 11 users creating more than 2 new accounts, and one creating 6!

The number of users that accessed either of the prototypes since January 1, 2006, that is those most likely to have accessed the virtualMe, was 223 (221 excluding vMe – the researcher - and guest).

The guest account accessed V/2-Online and the virtualMe 335 times, which would be a combination of those accessing the prototype to “have a preview”

and those students who did not wish to create user profiles. Unfortunately the guest counter ceased working from mid 2006 and was only detected late in 2007 so the number of times guest was used to access the prototype is unknown. However when the snippet usage logs are reviewed, the guest account is found to have visited 845 individual snippets a total of 2,782 times.

### 10.3.1.2 User activity analysis

In order to evaluate and analyse user activity, data for each day was collected and included: the number of logins, the number of snippets viewed as pages and OHTs, the number of annotations made, and the number of users per hour that accessed the prototype. This data proved useful when determining how the overall prototype was being used and the data was displayed in the format as shown in Figure 10-9. The data was collected from February 9, 2006 through to December 2, 2007.

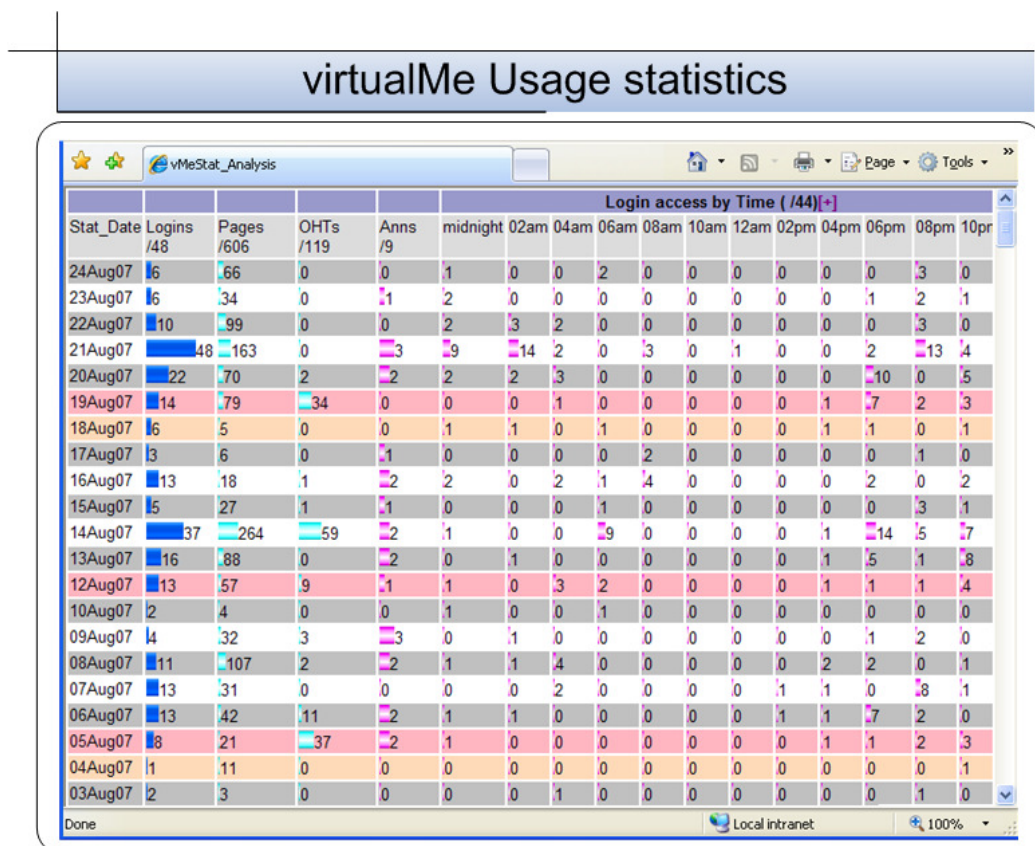


Figure 10-9: Usage data collected as a user logged into the prototype

The headings in the logins, pages, OHTs and annotations columns also show the maximums (48, 606 and 9 respectively). Login access by time shows the times aggregated into 2 hour slots, although a one hour display was also available. Different fill colours were used to highlight the days in a weekend. Figure 10-10 is a summary for data collected in 2007, as in 2006 the data was made up of a mixture of that from the virtualMe hosted at Massey University in New Zealand, and the virtualMV hosted in the United States. In order to analyse the time data, a time zone adjustment is required as New Zealand is 18 hours ahead of the server host time zone (USA).

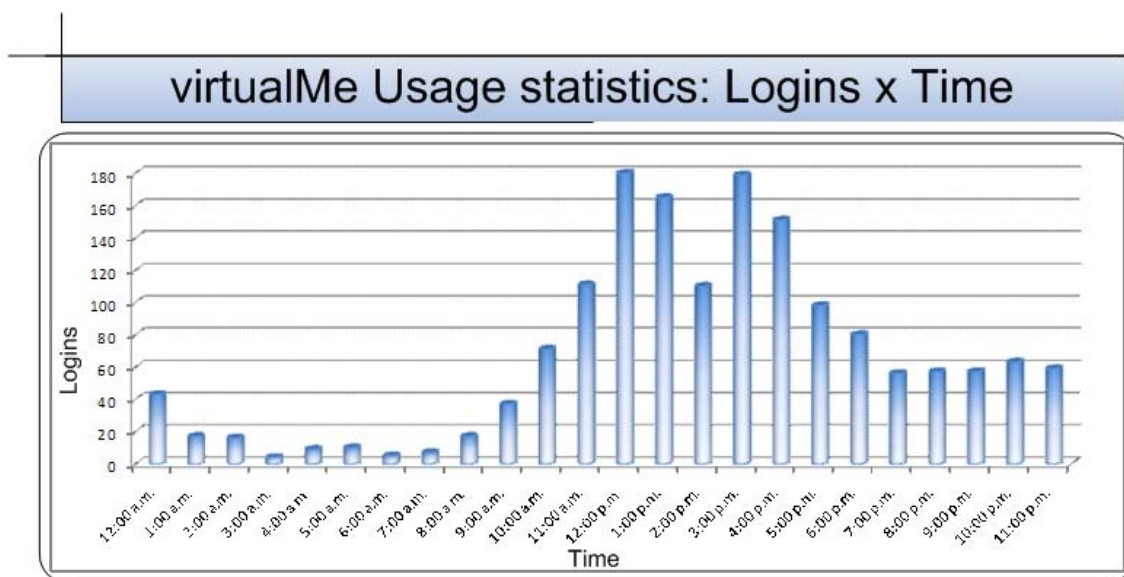


Figure 10-10: 2007 Usage statistics showing logins vs. time

Is 24 hours, 7 days access useful in an online teaching and learning system? As can be observed in Figure 10-10 usage of the prototype generally occurred between 10:00 a.m. and 1:00 a.m. with usage dropping in the early hours of the morning. As the prototype was also being tested on a global scale it would be expected that some activity would take place in the early hours. Although it is possible to make some observations regarding the 7 days access this has been left for possible future research.

### **10.3.2 Analysis of the development log**

Evolution and implementation of the prototype occurred from October 2005 through 2006, with minimal changes made during 2007. In semester 1, 2006 the prototype was primarily run from a server hosted at Massey University. For many reasons, during August 2006, this was shifted to an externally hosted server (<http://www.brinkster.com> with the URL <http://www.virtualmv.com>), and parallel implementations were run. The user data was merged in December 2006 and with Massey server decommissioned, <http://www.virtualmv.com> was used exclusively during 2007.

During the implementation phase a log of changes was maintained, and an analysis of the log gives some indication of possible bias in student feedback. It should be noted that some of the students would have used the prototype in both 2006 and 2007.

In August 2006 it was discovered that adding annotations to a snippet when in overhead view was not possible. This was tracked back to the code that allowed for a PowerPoint remote control to work with the prototype. Students in the Internet and Web design class were required as part of an assessment to enter an annotation and due to this problem many were not able to. An alternative method was given so that the students were not disadvantaged, but it is expected that this would have introduced some bias as to the prototypes usability.

Another issue during this time that was not sorted out until early 2007 was a short time out limit set by the server, and this took a while to find a solution and students experienced frustration with it.

In July 2006 a group of students in a Systems Analysis class being taught by a colleague, used the prototype as a class exercise to investigate usability. Aggregated feedback was compiled and based on their suggestions modifications were made to the prototype.

Another problem that surfaced in April 2006 was that the prototype locked the database preventing users from logging into it. At this stage a static alternative to the site was built to ensure students could still get access to the material. This “bug” was resolved during September 2006 so did not affect the results for 2007.

The impact of issues mentioned can be seen in Figure 10-8 where although the courses taught in semester 2 2006 and 2007 were the same and with approximately the same number of students (approximately 28), access during 2007 was much greater.

### **10.3.3 Conclusion**

This chapter discusses observations and reflections from the virtualMe prototype implemented to support the research into the virtualMe framework. The prototype was shown to provide the capability to acquire information and knowledge in context using a snippet and multimedia object model and annotation framework, to support manage the three knowledge types : explicit, tacit, and missing.

The framework identified the usefulness to view content in multiple ways to support teaching and learning, that is: overhead (for teacher delivery), page (for student online reading) and consolidated hardcopy (for student offline reading). Students’ use of print, page and overhead views were compared. The majority of students preferred to view the prototype as discrete snippets, but there were a few who relied extensively on the print facility, particularly students with English as a second language. Examples of what could be identified as a successful snippet and as expected those most accessed were where they directly related to student work, however, a snippet that demonstrated an unusual “magic-eye” effect also proved very popular. How the prototype addressed Chickering and Ehrmann’s (1996) “seven principles of good practice” was also discussed, with support for active learning, access

online to support time on task, and the ability to support diverse ways of learning.

The prototype implemented mechanisms for acquisition, management and dissemination of information and knowledge based on the virtualMe framework. The snippet and MMO models managed content, while annotations handled the acquisition of knowledge from users, and helped identify missing knowledge. An analysis of the annotations identified that when this mechanism is made available, they were used primarily for adding information and knowledge in context. Annotations also support three of the seven principles of good (teaching) practice, by providing a mechanism to support contact between students and faculty, cooperation between students and allow prompt feedback.

The virtualMe was compared to two existing systems: Moodle a learning management system, and WikiMedia a content management system. Comparing virtualMe to Moodle highlighted the disjointedness of Moodle's integrated content delivery system, the absence of an annotation feature, and the focus of the system on an institution and its courses. MediaWiki focuses on community collaboration, and does not provide extensive media support or the ability to present in the three modes: notes view (standard one for MediaWiki), overhead (no summary available – so all content is shown) and consolidated (though this can be done in part as a wiki page is a combination of “snippets”).

The chapter also considered observations made from the usage data, and from a log kept during the implementation of the virtualMe prototype. The usage data showed that for the virtualMe 47,781 snippets were viewed. Looking at the user profiles, the issue of users forgetting passwords and creating new ones was evident with 68 out of 496 (14%) user records being duplicates. Usage data showed students accessed the system 24 hours 7 days a week, emphasising the usefulness of online availability. Issues with time zones were also noted. Since the server was hosted in the United



States the time shown was that of the US rather than where the system was being accessed. The development log gave some indication of issues that affected the usage, and potentially bias that could follow through to feedback. A short time limit before the system timed out, and issues with adding annotations were identified.

This chapter concludes the discussion of the action research phases used to support this research. The following chapter looks at the desirable features identified by the action research in a framework that allows for the acquisition, management and sharing of an individual's information and knowledge that may exist in a variety of data types, at source in a teaching and learning environment. This is followed by considering questions related to conducting this research, identifying potential applications and considering future directions.

# **11 Research findings and discussion**

## **11.1 Introduction**

From the original observation that students can make a significant contribution to content in a teaching and learning environment, and a wish to utilise technology to support content acquisition, management and modification, the virtualMe framework was developed.

Using an action research methodology, successive prototypes were developed and evolved into the virtualMe framework. The problem statement for the overall framework to be addressed by this research was stated in Table 1 of section 1.9, as:

*What features are desirable in a framework that allows for the acquisition, management and sharing of an individual's information and knowledge that may exist in a variety of data types, at source in a teaching and learning environment?*

In the previous chapters observations and reflections on the virtualMe framework were described based on the prototype, usage and a user survey. Discussion centred around two areas: “information and knowledge acquisition”, and “mechanisms for acquisition, management and dissemination of information and knowledge”.

This chapter draws together the findings from the action research and presents a list of desirable features for a knowledge acquisition framework, considers possible limitations and discusses how the research has been presented to the research community.

## 11.2 Features for information and knowledge acquisition

In order to address the problem statement a list of features was developed. In section 6.2, design of the overall framework, 8 feature categories were listed as important for overall virtualMe framework, and were as follows:

1. Personal data, information, and knowledge need to be capable of being added in a controlled and consistent way.

This dealt with the actual schema, and in the case of the virtualMe was achieved via the use of a snippet and the multimedia object (MMO).

2. Personal content needs to be arranged and organized in a logical way.

This dealt with the taxonomy used to organize the snippets, and was achieved via an ordered list containing the topic areas, domains, and snippet links, plus the ability to link to external web pages.

3. Access needs to be by: the person managing the content (called the **virtualMe** or **vMe**), visitors that register (e.g. students, family, friends), and guests.

To ensure a degree of control on who could access the prototype a user identifier and login combination was used, though access was still possible via a guest account. The user identifier was created by the user, but did lead to them creating additional user identifiers when they forgot their passwords.

4. Interaction with the system for visitors is by annotating in context.

An extensive annotation capability was developed allowing for both out-of-context and in-context annotations. Survey results revealed that users found out-of-context annotations were not easy to add, but in-context, which was adding an annotation to a snippet, was easy.

This was supported by the analysis of the annotations actually added into the prototype.

5. Content chunks need to be “contextualized” and annotated in their context.

The snippet model allowed for content contextualization and as annotations could be added directly to a snippet the context of the annotation was maintained.

6. The user interface needs to:
  - reflect the personality of the owner of the portfolio, and
  - be user adaptable.

Provision of a personalised sidebar image gallery allowed the vMe’s personality to be emphasised. This was developed in the V/2-Online prototype and formed the basis of the MMO design. The usefulness of the MMO model was demonstrated in its ability to be automatically included as a new sidebar image by placing it into a sidebar folder. Captioning and contextual information was automatically generated, plus the ability to view multiple representations.

Multiple representations of media allows users to get more in-depth information about the object, for example, by selecting the image of a person this could link to a business card, other images or curriculum vitae (CV).

The virtualMe prototype implemented a limited number of ways for user personalisation. Users could adapt the prototype to their preferences through changing a style sheet, and could change the way icons were displayed. There were various technical issues that arose, and interestingly students did not perceive personalisation as a high priority, though this is consistent with other research where user adaptability increases in importance as users become more familiar with a system (Bush, & Tiwana, 2005).

7. The framework needs to provide benefits in a teaching and learning environment, including functionality to be:

- a teaching delivery mechanism;
- a self study (online or offline) assistant; and
- used to display material for discussion on a data projector.

All of these were achieved in the prototype. Actual lectures and training material were delivered, and feedback was received by the researcher on an ongoing basis. Students used the prototype to learn software packages via MMO's linked to snippets, that contained videos of the steps involved. In lecture sessions the snippets were presented on a data projector to the students using the overhead view, and students then referred to the content in a page view mode.

8. The framework needs to convey a sense of “interacting with a person” in a “community”.

This was not rated highly by users, though with the rapid spread in social networking sites this would need to be considered in any future development of the framework.

### **11.3 Features of a mechanism for acquisition, management and dissemination of information and knowledge**

As identified in the problem statement for this thesis, an important goal of this research was to identify the desirable features in the virtualMe framework. Organisationally the thesis has considered pedagogical issues (content, and teaching and learning) and mechanisms for the acquisition, management and dissemination of information and knowledge (resources, annotations, and learning management), and the following sections have been divided into these categories.

In addition, the features were developed to answer the following problem statements (refer to section 1.5):

***Overall framework:*** What features are desirable in a generalized framework that allow for the acquisition, management and sharing of an individual's information and knowledge in an educational environment?

***Annotation framework:*** What features are desirable in a framework that would enable other people to add information and knowledge that will benefit all users of the system?

***Resource acquisition, management and sharing at source:*** What features are desirable in an electronic digital asset model that has the ability to retain context while transferring the content from one person to another and from one place to another?

***Teaching and learning environment:*** What features are desirable in a blended (online and face-to-face) teaching and learning environment?

In the following features list, an indication as to which of the problem statements the feature can be applied to is included as well as a *surveyed* column that includes a cross reference to the survey questions in Chapter 9, with an indication as to the perceived usefulness.

In order to simplify the description the term **vMe** has been used to identify the owner/administrator/manager of the content.

### **11.3.1 Content**

To enable content to be managed a suitable schema needs to be developed. The virtualMe developed a five tier schema: system, taxonomy, snippet, MMO, and annotation. Annotation features are covered separately in the Section 11.3.4. Table 11-1 lists features identified as important when considering schema design.

Table 11-1: Content features: schema design

	Surveyed	Overall	Ann	Media	T&L
1. The system schema includes the following features:					
1.1. The ability to manage multiple vMe's on the same server. A logical separation was achieved via an editable XML file and a physical separation was achieved by keeping files in folders for the specific vMe.		✓			✓
1.2. Separation of "user data" such as user profiles, and annotations from content data created by vMe.		✓	✓		
1.3. The use of XML where appropriate to store textual data to allow for potential Semantic Web initiatives. This includes the text fields such as the summary and page view content in the snippet.		✓			
2. The taxonomy includes the following features:					
2.1. The ability to attach a snippet to give it context.		✓			
2.2. The ability to attach a snippet to an alternative taxonomy, for example, a snippet on multimedia could be relevant to other domains such as; internet, database, electronic design and photography.	4 100%	✓			
3. The snippet has the following features:					
3.1. A <b>mandatory</b> title and creation of auditing data (such as date and author).		✓			
3.2. A description, and optionally a summary that is used to display the snippet as an overhead, and if the summary is missing, the description is substituted.	2 96%	✓			✓
3.3. The ability to be used in many places in various domains (e.g., a snippet describing the gif file format can appear in notes for web and multimedia).	4 100%				
3.4. The ability to link to digital assets including multimedia elements and bibliographic entries.	4 100%	✓		✓	

3.5. The ability to select which of the media elements from an MMO should be displayed.		✓		✓	
3.6. The ability to provide definable analysis fields that can be used by the vMe. This allows research to be carried out on the snippets that arise at a later stage.		✓			✓
3.7. Flags to manage deletions and permissions (e.g., the snippet can be available only to the owner of the system).		✓			
3.8. A date to hide the snippet until the date specified is reached.		✓			✓

### 11.3.2 Teaching and learning

As the virtualMe framework was designed for use in a teaching and learning context, almost all of the features listed in this chapter relate to teaching and learning, for example: the ability to support content delivery in multiple views (overhead, page and print view); the ability to provide multimedia in multiple formats; and the capability to annotate to capture the missing knowledge, and provide a feedback mechanism.

On area specific to teaching and learning is social networking, and is an important component of the teaching and learning process, that is, *“Only a small part of individual knowledge is generated through the process of individual experience. Most parts are socially derived”* (Meisenberger & Seiwald, 2002, p.10). Basic social networking was implemented through the use of the annotations where users could leave messages to each other; the related features are listed in Table 11-2.



Table 11-2: Teaching and learning: social networking features

	Surveyed	Overall	Ann	Media	T&L
4. To enable direct communication between the system administrator and users a “sticky-note” feature was implemented. This was a panel displayed on the log-on screen so that issues related to the system could be communicated to users. The contents of the sticky note were entered into an XML file and read by the prototype. The global (out-of-context) annotation feature in the virtualMe framework allowed communication between the vMe and the user once they had logged in.		✓	✓		✓
5. To allow annotations that can be public, directed or personal to the system (global) by the owner (vMe) or visitors.		✓	✓		✓
6. To enable users to network with each other.	8 90%	✓			✓

### 11.3.3 Resource acquisition, management and sharing at source

The ability to acquire, manage and share resources has been handled in the virtualMe framework through the Multimedia Object Model (MMO), and features identified are listed in Table 11-3.

Table 11-3: Features for resource acquisition, management and sharing at source

7. The multimedia object (MMO) is used to represent any media element in the system and includes the ability to:					
7.1. manage multiple representations of the same media element;	31 94%			✓	
7.2. manage the digital rights;	30 94%			✓	

7.3.	display referencing information in a recognised style such as APA;	30 94%			✓	✓
7.4.	manage externally sourced media (e.g., YouTube, Flickr);				✓	✓
7.5.	provide a link to a possible alternative repository for media: e.g., local, CD/DVD, Internet (including an alternative Web site);		✓		✓	
7.6.	allow users to add an annotation (comment) that becomes part of the MMO/MVML file; and	21 100%		✓	✓	
7.7.	classify individual media elements so that they can be uniquely identified. This is important as it allows the selection of the default media element to be chosen for a snippet.		✓		✓	

In order for content to be effectively shared mechanisms need to be developed to display content. Features related to displaying content are listed in Table 11-4.

Table 11-4: User interface features, displaying content

	Surveyed	Overall	Ann	Media	T&L
8. A structure (taxonomy editor) that includes features such as: adding a new line, editing, deleting, collapsing, changing order, and opening in same or opening in new window.		✓			✓
9. The ability to show content in multiple views: page, overhead, and wiki.	1,2 97%				✓
10. The ability to aggregate content for efficient printing.	3 100%	✓			✓
11. The ability to have referencing information available on each page.	6 96%	✓			✓
12. For annotations, the ability to show subject headings for messages: from vMe to everyone, from users to everyone, to an individual, that are personal, and from user to vMe.		✓	✓		✓

13. For annotations the ability to aggregate and link back to snippet they apply to.		✓	✓		
14. The ability to display a hierarchical taxonomy containing: links to sub-taxonomies, links to snippets, comments, and links to external URLs.		✓	✓		✓
15. For parts of the taxonomy, the ability to: hide, and to provide secure access by password.		✓			✓
16. The ability to display a media element in a variety of ways.	32 100%	✓		✓	
17. The ability to provide quick-links when an MMO is used allowing hyper-linking to other media files in the MMO. For example, under a photo of a person a quick-link to the CV. One feature that was considered, but not implemented, was that each of the media elements in the MMO could be quick-linked via a small icon beneath the selected element.		✓		✓	
18. The ability to be able to re-aggregate a media element that has become separated from its MMO.				✓	
19. The ability to automatically create a URL links when @ symbol appears. Issues that need to be carefully implemented include:					
19.1. When a URL is part of a sentence and has a comma immediately following.		✓			
19.2. When a space has been included in the URL.		✓			

### 11.3.4 Acquisition of information and knowledge (Annotation)

An important way in which the information and knowledge can be acquired from users in a controlled and structured way is through annotations. Annotations can be used to allow users to communicate in the system, and include the features shown in Table 11-5.

Table 11-5: Annotation features

	Surveyed	Overall	Ann	Media	T&L
20. The ability to link annotations to snippets. This is the key to capturing information and knowledge, both from the owner (vMe) and from the users. Annotations that are added to a snippet <i>should</i> be in context.	19 98%		✓		✓
21. The ability to create out-of-context annotations at the system level. These could include generic comments, and linking to other existing tools used by the owner of virtualMe (e.g. Blog).		✓	✓		✓
22. The ability to create out-of-context annotations anywhere in the system, but aggregated in one place so they are not lost.		✓	✓		
23. The capability to separate aggregated annotations into logical groups including: those from vMe, from everyone, from specific users to you, and personal notes.	15-18 95%				
24. The ability to add annotations to an existing annotation (a thread). This is important as it allows an annotation to be replied to, which provides the ability for social interaction.		✓	✓		✓
25. The capability to create a wiki by making a copy of a snippet that a user can modify.	20 100%	✓	✓		✓
26. The ability to create annotations that are primarily text based.	22 100%	✓	✓		✓
27. The ability to create annotations that can be multimedia, and include both unstructured (e.g. image, audio, animation, video) and structured (e.g. Word, PDF, Presentation).	23 94%	✓	✓	✓	✓
28. Creating annotations in date-time order (functionally similar to blogging).			✓		✓
29. Including a start and end date that will allow an annotation to be entered early and displayed when relevant.			✓		✓
30. Including a hide and unhide feature to allow annotations to be easily filtered if necessary.		✓	✓		

31. Allowing annotations to be editable by the creator and the vMe. This prevents users adding extra annotations that correct a previous one and improves the management of the annotations.			✓		✓
32. Allowing users to rate an annotation.			✓		
33. The ability to provide definable analysis fields for an annotation that could be used by the vMe. This allows additional research to be carried out on the annotations at a later stage. For example, in the prototypes this was used to indicate whether an annotation was optional or mandatory.			✓		✓
34. Allowing annotations to be targeted to user groups. This could include:					
34.1. public, where it is viewable by all users;	16 92%		✓		✓
34.2. directed, where a specific user or user group is specified; or	14 98%		✓		✓
34.3. personal, where a note can be made to store personal comments (although they could be viewed by the owner of the virtualMe).	18 92%		✓		✓

### 11.3.5 Learning / content management system

Features that are appropriate to learning / content management systems include: collecting user data, collecting statistical data, user interface, personalisation, accessibility, and maintenance options.

#### 11.3.5.1 Collection of data about individual users

When users are created there is an opportunity to capture data that can be used to help uniquely identify the users (e.g. user identifier, first and last names, email address), control access (e.g. users access rights), gather demographic data (e.g. age, gender), and enable the system to deliver personalised features (e.g. screen display, learning style preferences). Table 11-6 lists features related to collecting data about individual users.

Table 11-6: Content features, user data collection

	Surveyed	Overall	Ann	Media	T&L
35. A technique to create and manage user identifiers and passwords. In the prototypes anonymous user identifiers and passwords were created by users. The advantages of this approach were that the administrative function of creating users was done by the user, as is common on many online systems today.		✓			
36. The ability for a user to recover their user identifier or password. This was not well implemented in the prototypes and led to users creating additional user identifiers when either was forgotten. A technique that is in common use is to enter an email address, and if a match is found, to send the user-id and password to the email address. The downside of this technique is that a mail-server needs to be running capable of sending the email, but the upside is that it confirms that the correct user receives the information.		✓			
37. The capability to assist in research, by including:					
37.1. A valid email address. This proved invaluable when conducting the survey.		✓			✓
37.2. An opt-in option to allow for future research from system. This has become a legal requirement in New Zealand to avoid spam. Interestingly one of the students made the comment <i>"I am really glad that you are still in touch with me though i am far off sitting in Mumbai, India"</i> .		✓			✓
38. Including a field that identifies the relationship with the virtualMe, though this proved to be problematic as the relationship can change over time.		✓			✓
39. The ability to manage user permissions. In the prototypes the administrator (or vMe) had full access to the taxonomy, and could restrict access to some of the options. Users could be assigned to a group and given specific access, and guests could be identified and given restricted access.		✓			✓

40. Including a field to store age range. In the prototypes this was not included when a user <i>created</i> their profile. It is probable that more users would have filled this out had this been so, rather than expecting that they would update their profile with additional data at a later stage. Other demographic information such as gender was not collected in the prototypes.		✓			✓
41. The ability to auto create an APA style reference for each page from the vMe's name. This requires the name to be structured into: last, first, initials, and allows the system to auto-create the reference from the template:  <i>&lt;lastname&gt;, &lt;initial&gt;., (date) &lt;page title&gt;. Retrieved &lt;today's date&gt; from &lt;url&gt;</i>		✓			✓

### 11.3.5.2 Collection and display of statistical data

Since Internet technologies have been used in the prototype there was a capability to automatically collect much statistical data. This included: usage data, such as when a user accessed the system and how often; and tracking data, such as which snippets were accessed and how often. Table 11-7 lists features related to the collection and display of statistical data.

Table 11-7: Content features, statistical data

	Surveyed	Overall	Ann	Media	T&L
42. The ability to collect statistical data, and includes the following features:					
42.1. How many times a user logged in and when.		✓			✓
42.2. Tracking a user's movements through the system.		✓			✓
43. The ability to present the usage statistics, such as:					
43.1. For each snippet how many times it was viewed by a single user and by all users (This was implemented in the V/2-Online prototype).		✓			✓

43.2. Times users logged in by date. This was implemented in the virtualMe prototype and gave an interesting view of 24 hour 7 day access.		✓			✓
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### 11.3.5.3 User interface

An important part of the user interface is the way a user is able to navigate, and this affects the usability of a computer based system. Table 11-8 lists navigation features in the virtualMe framework.

Table 11-8: User interface features

	Surveyed	Overall	Ann	Media	T&L
44. An ability to see where you are relative to the overall structure. In the prototype this was implemented through a “breadcrumb” trail displaying the hierarchy required to navigate to the page displayed.		✓			✓
45. An ability to show where you are in a sequence of snippets. This is important when a user is viewing a snippet in page view, or a lecture in overhead view, to allow chaining to the previous or next snippet.		✓			✓
46. Previous and next buttons suitable for use on an electronic whiteboard. This was necessary particularly in lectures where a button in a consistent position on the screen was available to move to the next or previous snippet.		✓			✓
47. The ability to remotely control display when in a lecture mode. Often in a lecture the computer delivering the presentation may be at a distance from the presenter. In this case a remote device is often used to move slides forward or backwards. The ability to be able to do this was implemented in the prototypes and was a useful feature when delivering to a class.					✓



48. The ability to search through all snippets. This was implemented in a limited fashion in the prototype. Students did comment that in the prototype this option was difficult to find.		✓			✓
49. The ability to search and display all MMOs. This option was implemented but available only to the vMe. Users did not indicate this was something they missed, however it should be considered in the design of any similar system.		✓		✓	✓
50. The ability to access the snippet content from an Internet server but provide alternative sources for media elements. In the case of the prototypes 3 different locations could be set for the MMO media files as follows:					
50.1. On the server where the virtualMe prototype was hosted. This was the default setting.		✓		✓	✓
50.2. On a local drive. This could be fixed drive such as an internal hard disk drive, or removable drive such as a CD-ROM/DVD or memory stick. This enabled a user to access the content online via a slow internet connection but provided the advantage of sourcing media elements locally. This meant that the content was current, but images did not require a significant bandwidth requirement, giving improved display performance. A drawback of this, unfortunately, was that this feature is only available on Microsoft's Internet Explorer.		✓		✓	✓
50.3. On a network drive. As many organizations have firewalls restricting access to certain media elements types such as videos or sound files placing the elements on the organisation's network prevented this occurring.		✓		✓	✓
51. The ability to do a reverse search. For example: given a snippet, find out where else it was used; for an MMO find out what other snippets it has been used with; and from a list of annotations which snippet it was attached to.		✓	✓	✓	✓
52. The ability to display the current time correctly. As the system would be Internet based there is a need to set display the time zone that the user is in, not that of the server. This created some interesting issues in the prototype when two instances were running on		✓			

separate servers, as for example when a snippet was added it took the time stamp appropriate to the servers' location. This created some interesting issues when the databases were merged. The blogging software WordPress ( <a href="http://www.wordpress.com">http://www.wordpress.com</a> ) has a time zone adjustment facility that addresses this issue.					
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#### 11.3.5.4 Personalisation

Personalisation gives vMe the ability to create a unique interface that reflects a user's personality, and gives users the feeling that they are interacting with a person rather than a system. Allowing users to change parts of the interface gives them a sense of ownership. Features related to personalisation are listed in Table 11-9.

Table 11-9: User interface features, personalisation

	Surveyed	Overall	Ann	Media	T&L
53. The ability to display a randomised image gallery specific to the vMe. A useful feature implemented was the ability to filter when an image was displayed based on month e.g. Easter, Christmas. In the prototypes the last two characters of the image's name were used to define the start and end dates with 1-9 representing Jan-Sep, and A-C for Oct-Dec, for example <i>2008Easter34.jpg</i> would display in March and April and <i>2007ChristmasCC.jpg</i> would only display in December.	9 88%	✓			✓
54. The ability to change the look of the site using style sheets. This includes different styles for page layout or overhead layout. For an overhead display some users preferred a dark scheme while others a light coloured scheme.	5 86%	✓			
55. The ability to select different referencing styles. In practice the APA style was the only one implemented and as this was the format used by the researcher's institute there was no demand for alternative styles.	5 86%	✓			✓

Also, too manually convert from one style to another is not a major task, the issue being that there should at least be one available.					
56. The ability to display icons in different ways. In the prototypes it was possible for icons to be displayed as image icon, icon plus text or text only.	5 86%	✓			

### 11.3.5.5 Accessibility

Web accessibility refers to “*removing obstacles that get in people’s way*” (Neilson & Loranger, 2006, p. 226), and includes features to help those with physical (e.g. visual, audio, age), mental (e.g. learning styles) or environmental (e.g. slow connections) problems. Features related to accessibility are listed in Table 11-10.

Table 11-10: User interface features, accessibility

	Surveyed	Overall	Ann	Media	T&L
57. The capability to provide alternative representations. As the MMO allows multiple representations of any media object, this enables users with restricted capabilities to access the element in a suitable form, for example, a vision impaired student could access an audio representation.				✓	
58. The ability to provide tooltip help for words that may require further explanation. In the V/2-Online prototype, as a snippet was displayed, a tooltip was created for words in the glossary.		✓			✓
59. The ability to include a language translation feature. In the researcher’s Institution students came from many countries, primarily to learn English and there was benefit in providing a tooltip popup translation for some of the technical words and phrases.		✓			✓

### 11.3.5.6 Maintenance options

In order to maintain the usability, functionality, and integrity of the system, a variety of administrator features are required. Table 11-11 lists features available to the administrator (vMe).

Table 11-11: Maintenance features

	Surveyed	Overall	Ann	Media	T&L
60. The ability to list all users by: most recent, user id, last name, and new users with edit capabilities (particularly to change the password).		✓			
61. A facility to manage files in the system. This was needed to: display files in folders, allow files to be edited using a text editor (in the case of an MMO or XML files), allow files to be deleted, allow files to be displayed, and also to allow the creation of new folders for MMO files that would insert the MVML template into the folder.		✓			
62. An MMO file creator (refer to chap. 9.5.1), that has the ability to:					
62.1. take an image and automatically generate additional files such as a thumbnail, screen version (width = 295 pixels) and print version (width= 595 pixels);				✓	
62.2. capture system data such as date created, filenames, sizes, durations, dimensions; and				✓	
62.3. include data from the MVML template files such as, author details.				✓	

### 11.3.6 Miscellaneous features

Other features that were either found useful or trialled in the prototypes are listed in Table 11-12.

Table 11-12: Miscellaneous features

	Surveyed	Overall	Ann	Media	T&L
63. The ability to copy a media object containing contextual information such as author, ownership and a description.	33 96%	✓		✓	
64. The ability to be easily run on, or transferred to alternative servers. Interestingly the prototypes were developed over three different servers: a local version running on the laptop for development, the is-research server (Massey University), and Brinkster. In Brinkster's case upgrading the hosting plan gave two very different structures in the physical layout and this created many issues.		✓		✓	
65. Provision of a guestbook feature. In the virtualMe prototype this is handled by the annotation functionality so is now no longer needed. In the V/2-Online prototype the guestbook became the target of extensive spam attacking and eventually was disabled. The "spam" problem was also experienced by the researcher in an open discussion forum for NACCQ and this too was ultimately shut down. This highlighted the importance of a userid/password combination for online content systems.		✓			✓
66. The inclusion of a code table to manage addition of structured codes, for example, system information such as: copyright notice featured at the top of each screen; links to email accounts of the vMe; and any database fields that may have set codes, such as, annotation analysis.		✓			
67. The ability to provide a static alternative for the Web site content. This was important for students particularly when the server was unavailable. The static alternative can also be provided on CD so that an offline version can be made available to users with a particularly slow internet connection.		✓			✓

For future development of either the virtualMe framework or other teaching and learning systems the checklist could be used to identify features that could be considered for inclusion and implementation.

## **11.4 Issues, limitations and resolutions**

The research described in this thesis was based on an action research technique, through the design, implementation, and usage of prototypes; and a user survey.

Several issues surfaced during this research through using the prototyping methodology and matched those identified in literature: continuous code and repair cycle, scope creep, and performance (Bentley & Whitten, 2007). The continuous code and repair cycle creates maintenance issues, and provided many challenges. With the development prototype on a laptop, and at one stage two live prototypes running concurrently, maintaining all three systems with very different physical structures was difficult. During the research it was identified that there was a high probability that the New Zealand host server would be terminated (as happened), so steps had to be taken to transfer all users and content to an alternative host.

Since one of the expected outcomes of the research was to develop a list of features desirable for the virtualMe framework, the issue of scope creep and complexity needed to be managed carefully, as this could “*escalate beyond initial design specifications*” (Bentley & Whitten, 2007, pp. 448-450). Scope creep is a significant issue in computer based projects, and not addressing this is a common cause for failure (Wieggers, 2000). In some cases, features that were useful in the V/2-Online prototype were not implemented in the virtualMe, for example, the glossary tooltip and language conversion tooltips.

Performance problems are identified as an issue related to the choice of prototyping (Bentley & Whitten, 2007), and using Microsoft Access as the back-end database proved to be a factor influencing the prototypes’

performance. Contact with the off-shore hosting company suggested that MySQL or Microsoft SQL Server would be a better choice, but as the prototypes were running on three different hosts (laptop, is-research server and Brinkster server) this would have required significant recoding. Performance issues arose when delivering the content in lectures, and comments were made by respondents in the survey, and also by students when using the prototype for their studies. It is possible that this could have limited the usage of the prototype and therefore influenced the comments, but from written comments this does not appear to be significant factor.

Issues that occurred during data collection were described with resolutions in section 9.2.2 (Survey), and included:

- The availability of the prototype.
- Emails requesting participation in the survey ending up in spam folders.
- User opinions being influenced by the design of the system or their experiences with the technology.
- Only technically competent users filling in the survey.
- Teaching methods impacting on students' perception of the value of the system.
- Requiring respondents to perform three activities: learning a new system, playing with the functionality; and then completing a survey.

Since the survey required a considerable commitment from respondents, a large local and international sample set was contacted for feedback. As of 11th March 2007, 56 responses were received and based on the demographic data, this represented a good cross section of potential users, both locally and internationally, a good gender balance, and covered a wide cross section of the teaching and learning community.

While the number of responses could be considered small in relation to the population being sampled, this is counterbalanced by the high degree of consistency of the results.

## **11.5 Techniques to support the research**

Four techniques were used to develop the features listed in this chapter and include:

- prototype implementation and usage,
- survey,
- refereed publications, and
- presentations at conferences and workshops.

### **11.5.1 Prototype implementation and usage**

The use of participatory action research, through the use of working prototypes, provided an important technique to develop the features desirable in the virtualMe framework. With almost 500 unique users for both V/2-Online and virtualMe prototypes, of which 221 (excluding guests) were likely to have accessed the virtualMe prototype, and in excess of 55,000 page views up until December 2007 the prototypes and features were extensively tested.

### **11.5.2 Survey**

To validate that the features suggested were desirable, a user survey based on the Technology Acceptance Model (TAM) (Davis, 1989) was conducted, and the findings were described previously in Chapter 9. For the overall framework at least 82% of respondents indicated that the prototype and its features were perceived to be useful or very useful, and in most cases this was in excess of 90% (Table 9-3).



### 11.5.3 Publications and presentations

The research was further developed through peer reviewed publications, and national and international conference presentations. An extensive publishing record has been achieved throughout the evolution and development of this thesis, and includes:

- **four book chapters** (Verhaart & Kinshuk, 2006a; Verhaart & Kinshuk, 2006c; Verhaart & Kinshuk, 2005a; Verhaart, Jamieson, & Kinshuk, 2004);
- **two journal papers** (Verhaart, 2004b; Verhaart, 2003b; Verhaart, 2008);
- **eleven conference proceedings and presentations** (Verhaart, 2007; Verhaart & Jamieson, 2007; Verhaart & Kinshuk, 2007; Verhaart & Kinshuk, 2006b; Verhaart, 2006; Verhaart & Kinshuk, 2004a; Verhaart, 2004a; Verhaart, Jamieson & Kinshuk, 2004; Verhaart & Kinshuk, 2004a; Verhaart & Kinshuk, 2004b; Verhaart, 2002); and
- **two technical reports** (Verhaart & Kinshuk, 2005b; Verhaart, 2003c)

A list of the publications and their abstracts are available in Appendix F.

## 11.6 Conclusion

The overall research question addressed by the virtualMe framework as stated in the introduction was:

*What features are important in a framework to acquire contextualized information and knowledge that may exist in a variety of data types, at source?*

This chapter presented the findings of the research and contained a list of desirable features, identified those that were specifically targeted in the

user survey and suggested which of the framework areas the feature could relate to. Four ways in which the feature list was developed were identified: prototype implementation and usage; survey; refereed publications; and presentations at conferences and workshops.

Throughout the research there were many instances where decisions were made or additional research was suggested. Indeed the research is part of a continuum and although complete within its scope there are many things yet to be explored or that could be expanded. The next chapter reflects on the research process and findings and looks at possible future work to extend this research.

## **12 Reflection, potential applications and future directions**

### **12.1 Introduction**

As mentioned in Section 2.2.5, there are many things that can be reflected upon when concluding a thesis: what was learnt in the process; what could have been done differently; what are personal strengths and weaknesses; and so on.

This chapter discusses the following questions: how can the findings be applied, what advantages were found using the research methodology, what were the challenges, what would be done the same, what would be done differently, what things would not continue and what things are worth further investigation? It concludes with looking at how the findings could be applied to existing systems.

### **12.2 Reflection**

#### **12.2.1 Impact of findings on teaching and learning practice**

How could the findings be applied in teaching and learning? With the perceived usefulness of many of the features exceeding 90%, the list of features could form the basis of a best practice list for teachers when developing online and technology assisted (blended) materials.

While custom prototypes were developed to test perceived usefulness in this research, existing learning management systems (LMSs), such as Moodle, could benefit by implementing some of the suggested features. Many of the features could be implemented in part or in full as add-ons or plug-ins, such as the snippet structure, the multimedia object (MMO) and annotation capability.

The snippet model could provide many benefits to existing systems including: the ability to be viewed in different ways (page, overhead and print), the ability to be reused in other contexts (this allows a user to see how the information relates in other areas), have attached annotations (which are available wherever the snippet is used). Some systems include a snippet like structure, for example, WordPress (<http://www.wordpress.com>) blogging software uses pages that can have media elements and comments attached.

For a student there are benefits in constructing an online personal information and knowledge repository, and the structures suggested in this thesis could assist, for example, using a wiki construct to create a copy of existing content that can be personalised.

The V/2-Online prototype highlighted the problems of having annotations separated logically by course, for example, if a course was not currently being taught, questions posted by students were often missed. One important feature therefore is that annotations need to be consolidated, and this would be a feature that would benefit existing LMSs and other online systems.

### **12.2.2 Advantages of conducting the study in this way**

In Chapter 2 (2.1), the overall aim of the research was stated as “*to develop a metadata schema to enable the acquisition of information and knowledge in context at source in a teaching and learning environment*”. This evolved from an observation that when lecturing or teaching students, often their experiences and knowledge, which could be of significant benefit to all, are not included. This may be due to time constraints, shyness of students, or simply no opportunity for the students to contribute.

As the researcher was and is involved in tertiary education and training, plus is an information technology specialist, this provided an opportunity to

explore how technology could be used to facilitate acquisition of students' information and knowledge. Web based technology evolves rapidly, with new innovations constantly appearing, and while this provides opportunities for research, it can be overtaken with the advances occurring. Since this research spanned an extended period of time, it was critical that the ideas proposed and researched could evolve with the technology. This also meant that it was important that the research was published as it was happening rather than in the more traditional way, of conducting the research then producing a final publication.

In a sense this thesis describes a story of the research, how it evolved over time and the observations and conclusions that occurred at various points. The five phase methodology based on Bourner (2002) was illustrated in Chapter 2, (Figure 2-1), and a revised version based on actual experiences is illustrated in Figure 12-1.

The initial diagram suggested a linear relationship between the phases, but as illustrated in Figure 12-1, "reviewing the field of study" and "theory building" was cyclical, and concurrent as the literature was reviewed and the framework was designed.

Some advantages of using this technique included: teaching and learning support was provided as features were implemented; the research could be informed on an ongoing basis, with rapid feedback; features could be added as new requirements were identified by both the researcher and the users of the prototypes; and the ability to trial features considered useful, and observe whether they were actually useful to users (e.g., although a snippet wiki feature was implemented, it was not used by students, but in the survey this feature was perceived to be useful. This could be an area for future research).

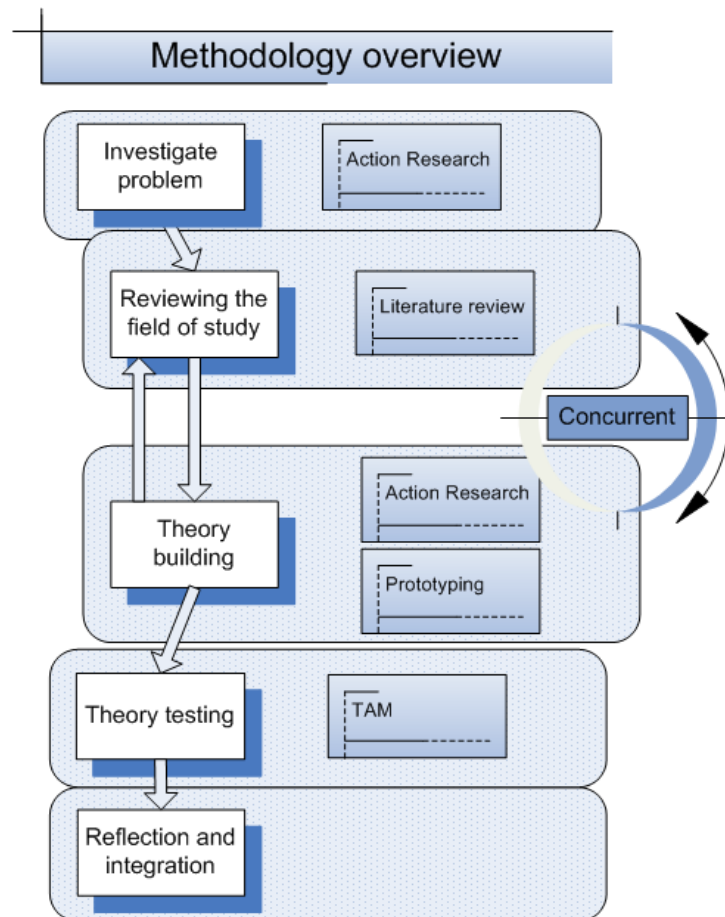


Figure 12-1: Revised research methodology used in virtualMe framework (based on Bourner, 2002)

Another significant benefit was the ability of the research to enhance teaching, with the prototype used in multimedia, database, and Internet and Web design courses. The prototype implementation could be applied to the concepts being taught, in areas such as: design, usability, media, database construction, accessibility, how down time as perceived by users, and so on.

### 12.2.3 Challenges while conducting the study

Many challenges arose during the study, and included both technology and human issues. From the researcher's perspective, personal skills need to be continually updated due to the rapid changes in Internet technology, in areas such as: development software, hosting solutions, and user interface developments.

As the study was investigating desirable features, managing scope creep was a challenge, as new features were continually being added. Some of the suggested features required significant coding time so this had to be balanced with the possible effects on the overall usability of the prototype. This meant that the prototypes were incomplete systems, and in some instances workarounds were required, such as, when adding a new file to an existing MMO, this was done manually. The annotation interface was rudimentary, and would have benefited from additional work.

Throughout the study, students were being exposed to a multitude of existing and emerging online systems, both as part of their course (e.g., Blackboard then Moodle), and in their personal lives, for example: social networking (Bebo, MySpace), Wiki (Wikipedia), email systems, discussion forums, list servers, spam mail, online results, blogs, and the prototypes used for the research. Care was needed to ensure that the prototypes did not duplicate existing systems and that students were not disadvantaged through using the prototypes. The cognitive load required to learn to navigate these systems would have had an impact on the time students were able to spend using the prototypes in this research.

As mentioned previously, another challenge was that to evaluate the virtualMe prototype, survey respondents needed to complete three time intensive tasks: learning, using and finally evaluating, and this had an effect on the response rate.

### **12.2.4 What things would be done the same?**

As the research covered an extended time period important motivators included: integrating the research with actual teaching; and the ability to implement features, observe their effect, and receive rapid feedback.

Following a cyclical participatory action research methodology also proved to be an advantage particularly as the technology and use of the technology was in a constant state of change.

## **Prototype development**

In order to validate the ideas presented in this thesis, several prototypes were developed. Developing custom solutions has both advantages and disadvantages. There is a significant cost in terms of time, with several technology shifts occurring during this study: from Windows Help files, to adding database functionality with Active Server Pages (ASP), to the introduction of Microsoft's .net framework. The Web based scripting language Personal Home Page: Hypertext Pre-processor (PHP) gained in popularity throughout 2005-2006, but there appears to be a move back to .net framework as this technology matures. Blackboard and WebCT learning management systems and the rise of the open source Moodle were potential environments that could allow for the development and testing of the virtualMe framework. Initially Blackboard was the LMS available to the researcher, but by the end of the research, had been replaced with Moodle. Had development been done in Blackboard, the change to Moodle would have had a serious impact on the research. Other disadvantages of using existing systems included: restrictions on creating additions to a system used by an institute, as access is carefully controlled, and proprietary LMSs such as Blackboard limited the ability to add additional features.

In practice, the institutional LMS's were used to manage the Institute related course information including, course outlines and handouts, while the custom prototypes dealt to the management of the information and knowledge sharing. This meant institutional policies were separated from the research while providing students with an acceptable alternative delivery mechanism.

Bentley and Whitten (2007) identified several possible prototyping disadvantages and these were listed previously in Chapter 2 (Section 2.2). Issues that arose during the research included: problems such as those experienced when the PowerPoint remote was enabled in the overhead view that disabled the ability to add annotations; and performance issues such



as using Microsoft Access as the back-end database. Overall, the ability of the prototype to evolve rapidly and its ability to have additional features implemented far out-weighted these problems.

### **Survey**

Regarding the survey, a significant factor that improved the response rate was collecting email addresses, and including a statement that the prototypes were being used for research. As the prototypes were run independently of the researcher's institutes LMS the email addresses tended to be those that the students actually used rather than those allocated by the Institute. Further, student profiles, including their email addresses are terminated when students are no longer enrolled in the courses so contacting them can be difficult, if not impossible.

### **12.2.5 What things would be done differently?**

Performance was a significant issue identified both from the use of the prototypes and feedback from the users. A decision to host the prototype with an international company meant that the connection speed was influenced by international usage. Sourcing a local or national host would have been better.

The second significant area that should have been addressed was the back-end database. Microsoft's Access was well understood by the researcher; however it has limited Web access capability. On reflection, the use of a database such as MySQL or MS-SQL Server would have had a significant effect on the robustness of the prototype.

An issue that proved more time consuming than necessary, was that of users forgetting their passwords. Some users created multiple profiles that required manual matching when preparing the data for analysis. Creating a simple and robust way for users to recover their passwords would have been

time well spent. Also, this was time wasted by the users as they tried to retrieve their passwords which also affected their user experience.

### **12.2.6 What things would not be continued?**

The development of a customized solution for the research proved to be a significant advantage, in terms of managing technology change and allowing features to be changed independent of the Institute's system of the researcher. However with a feature list defined, developing a way for these features to be incorporated into existing LMSs would be preferred in future research as this would be useable by the e-learning community. For example, the MMOs could be implemented using a shockwave plug-in following the YouTube model.

### **12.2.7 Potential use cases that could benefit from the research**

An important question asked while the research was in progress was, *“what value does the work undertaken have in the real world?”* The management of digital assets is a multi-million dollar problem faced by all organizations that manage them.

As an example:

*“On 9 March 2005 the European Parliament and the Council approved the eContentplus Programme, a multiannual Community programme to make digital content in Europe more accessible, usable and exploitable. The 4-year programme (2005–08), proposed by the European Commission, will have a budget of €149 million to tackle organisational barriers and promote take up of leading-edge technical solutions to improve accessibility and usability of digital material in a multilingual environment”* (European Commission, 2008).

The ability to add structured metadata that describes a multimedia object (MMO) in a common and consistent way, irrespective of the media type allows many applications to be developed. This separation of the media and their metadata from a specific application allows resources to be easily shared between applications.

The following discussion will describe various applications and indicate how the findings of the research could be applied.

### **12.2.7.1 Education and content management**

The prototypes developed in this research demonstrated the feasibility of using the virtualMe framework's features as a **teaching delivery tool**. Many of the features described could be implemented as part of existing learning management systems (LMSs), or indeed serve as the basis for a new LMS. For example, snippet or MMO support, or an integrated annotation system.

The virtualMe framework's features could be used as the basis for a **student portfolio tool**, using its ability to collect snippets of information and knowledge that could be captured quickly and organized easily, to assist in the recall of their body of knowledge.

A **content management system** (CMS), could benefit from the MMO, allowing multimedia to be viewed appropriate to the destination device (e.g., screen or printer) or in the correct context (e.g., on a web page). Reusing images often means re-describing the media and often the original context and creation information is lost. This can be amplified further when media is shared with other people. Figure 12-2 demonstrates how an MMO was used in the virtualMe prototype to display four pieces of information extracted from the MMO: the image, a caption, a tooltip and a link to the MVML manifest.

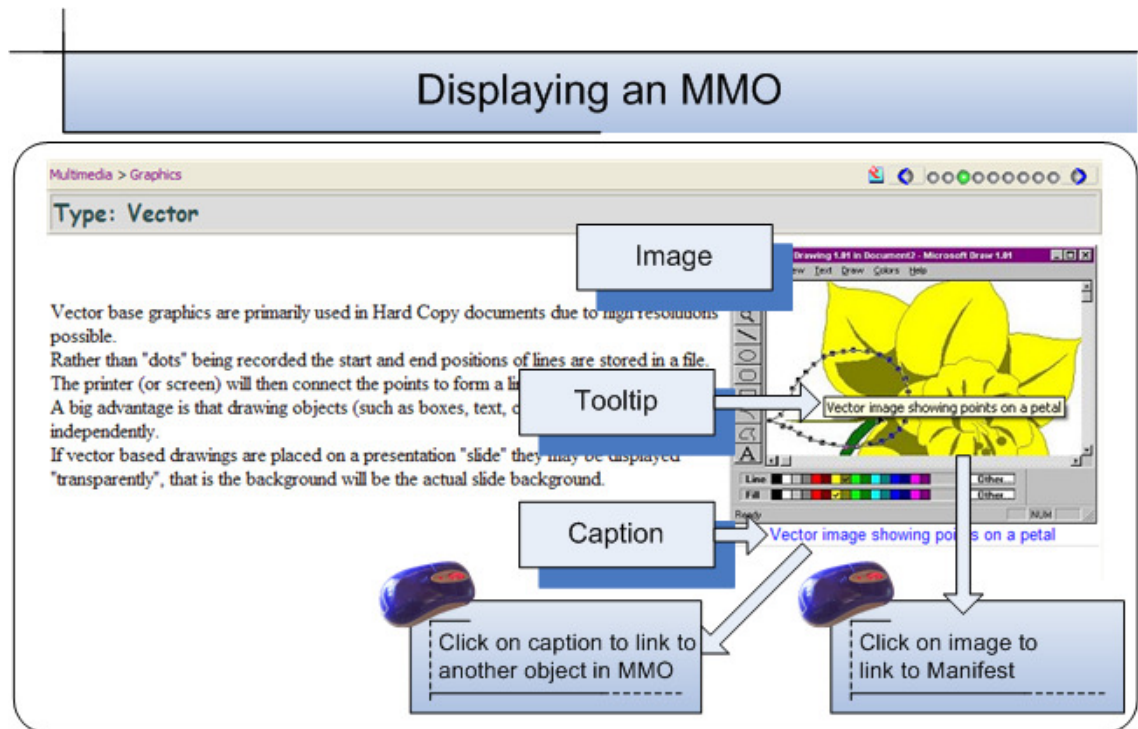


Figure 12-2: Displaying an MMO in a Content Management System

Using the MMO has other benefits, including: reverse referencing (e.g., in a web based CMS the pages that refer to the MMO can be linked).

#### 12.2.7.2 Contact and personnel management

A **business card manager** can be developed using MMOs. Using the multiple representation feature of an MMO for a business card could assist in recalling the person, for example, when: viewing an image of the person taken with a digital camera (or camera-enabled mobile phone), viewing a short video clip of the person, listening to an audio clip of their name (would assist in pronunciation). Figure 12-3 illustrates a business card viewer from the virtualMe prototype where: the actual business card was scanned, a vCard description is available (in the MVML file), and other media representations are included. Note the occurrence of both an English and Chinese business card (thanks to Professor Nian-Shing Chen for permission to use his business card to show MVML/MMO multi-language support).

## Business card display using an MMO

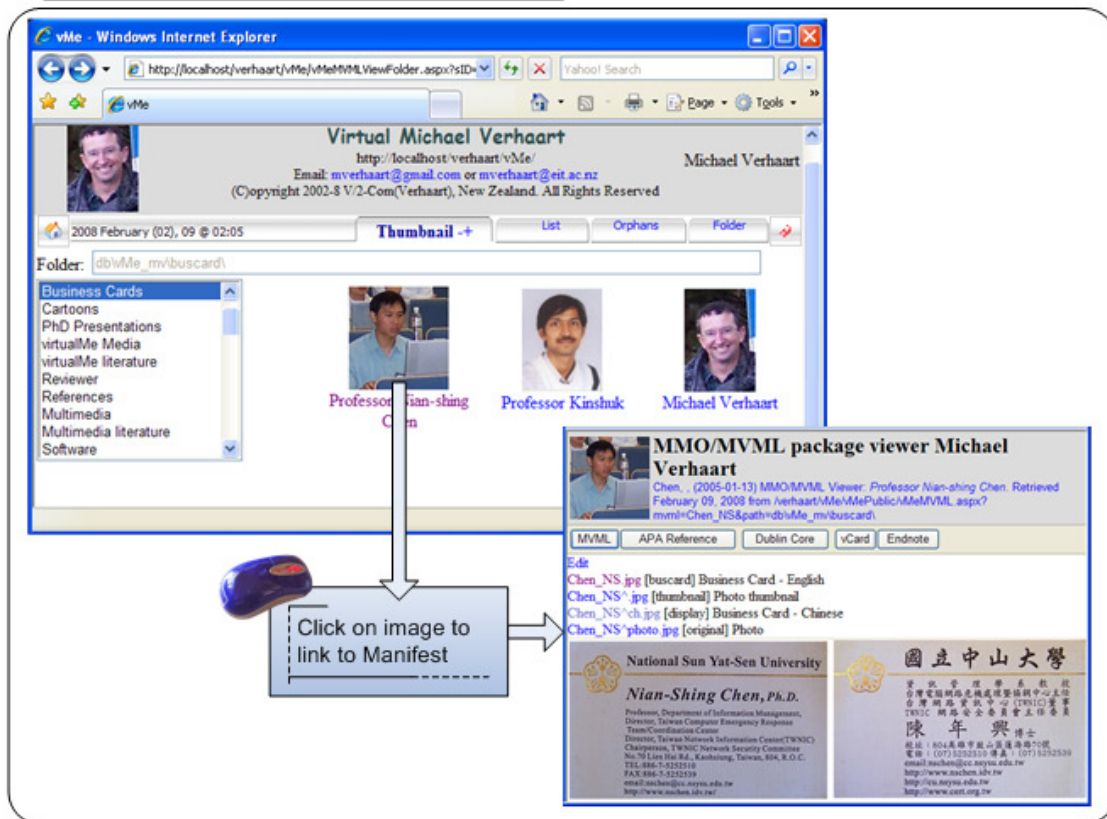


Figure 12-3: Business Card Reader based on MMO/MVML

A **contact management system** could be based on a collection of MMOs, and utilising the annotation capability. For example, when contact is made with the person, a structured annotation can be added to the MMO. Issues such as privacy, multi-lingual variations and cultural differences would need to be considered.

The MMO would be useful in **human resource management** for storing the personal profile, for example, a business card image, a text version of the card, a photo, a curriculum vitae, a video introducing the person, and a voice clip with the pronunciation.

### **12.2.7.3 Bibliographic and research management**

The MMO could be utilized in the **management of electronic bibliographic artefacts**, such as journal papers, books and book chapters. While online libraries such as the Association of Computing Machinery (ACM, 2008) provide citation information, most online sources require references to be manually constructed. If an electronic object (such as: a PDF, html or doc file) was encapsulated in an MMO, the MVML metadata could automatically create a referencing style or citation (e.g. APA), or other format (e.g. EndNote). The ability to annotate allows comments to be added to the object that could identify the salient parts relevant to the research.

Research requires considerable reading and data collection. Articles, books, journals, and Web resources are all combined with personal knowledge when producing a literature review. **Research management** is possible using the virtualMe framework, in particular the snippet structure for the researcher's notes and the MMO to manage the resources. The annotation capability allows for ad-hoc observations to be included.

Both the V/2-Online and virtualMe prototypes included features to test the feasibility of bibliographic management. Benefits that could be realised were the ability to extract the referencing and citation information, manage a local copy of the reference, and reverse reference.

### **12.2.7.4 Managing personal information**

A person's knowledge can be captured in an **electronic portfolio**, and this could include personal images and comments. Access could be restricted to family and friends, and the annotation feature would allow them to provide feedback. During the research social network applications such as MySpace, Facebook and Bebo emerged and have largely addressed this issue, but plug-ins based on the MMO could be used to extend their functionality.

### **12.2.7.5 Digital media organizer and slide show automation**

An obvious application of MMO is a **photo gallery organizer** or viewer. Although there are many such applications available, the most notable Flickr appearing around 2005 (Yahoo, 2008), most of them use proprietary databases to hold and manage the metadata of the images. As an MMO model maintains images in multiple formats, the application could choose the appropriate format for the destination device.

One possible variation with the MVML structure is the capability to create a related collection of images. For example, an MMO of a physical tree could be made up of images taken from different angles and perspectives. This would optimize viewing the album because similar images would be kept as a collection.

Since the files are stored with their metadata, an **automated slide show viewer** can be created showing not only the image but also a description of the image.

Reuse of the images in a Web site could be greatly simplified, because the captioning and tool-tip (ALT tag) information can be automatically generated.

Finally, the photo gallery would not be restricted to images. Many digital cameras/ mobile devices have the ability to capture video clips and with the addition of a representative image from the video, could be used as part of the photo gallery.

To demonstrate the proof of concept, basic slide show automation was created in the virtualMe prototype (Figure 12-4), where a random image was generated for the home page. The application was instructed to access a specified folder containing the MMOs, and by creating an MMO and copying it into the specified folder, the image, captioning, tooltip and link to viewer

were automatically created. Adding view start and end date tags to the MVML metadata allowed images to be displayed at specified times, for example, a Christmas image would only be displayed in December.

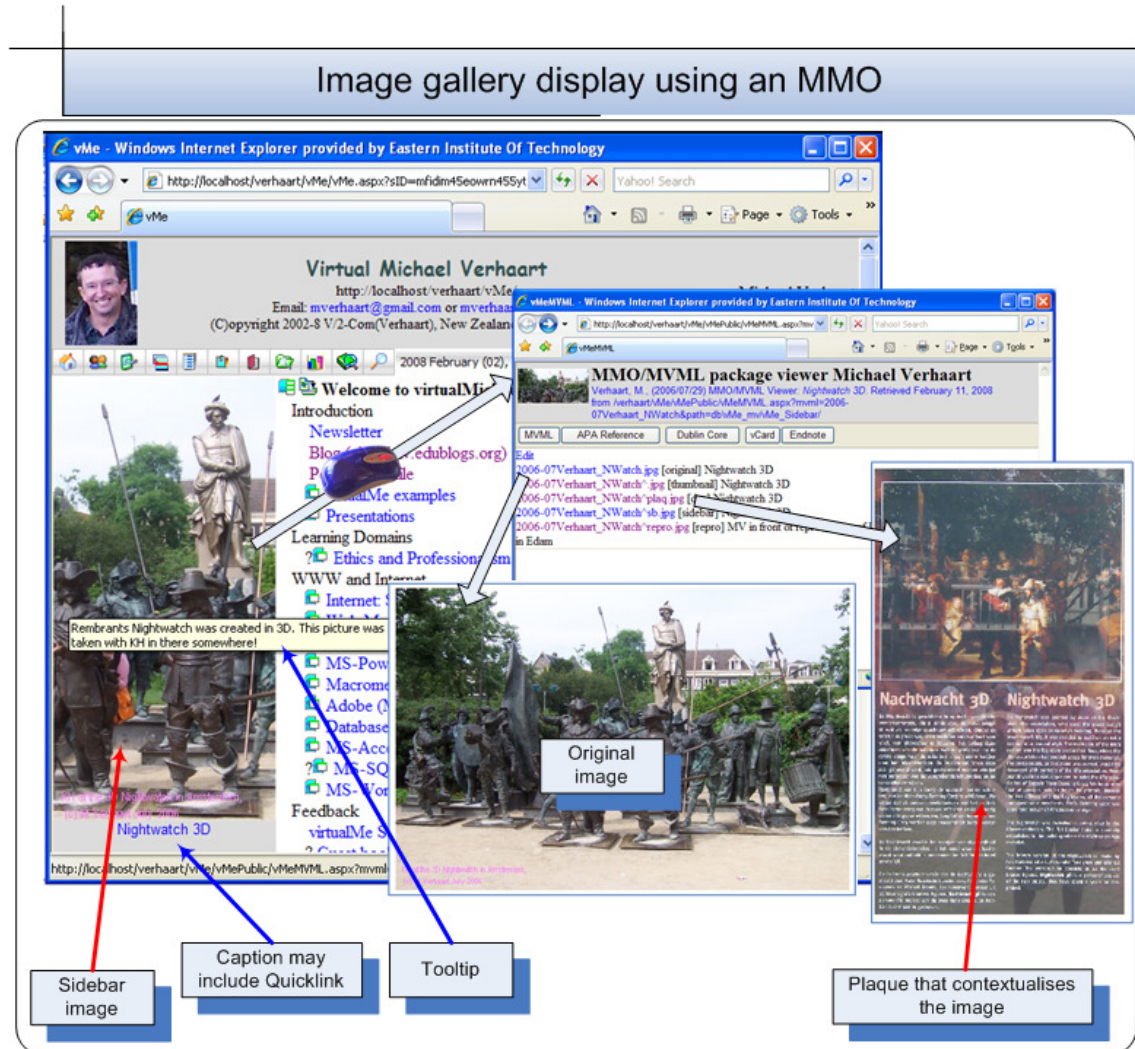


Figure 12-4: MMO as an image gallery on a web page

#### 12.2.7.6 CD/DVD identification system

The MMO model could also be used to manage CDs or DVDs. In the simplest case the songs on a CD are from the same group or individual, and from the same publisher. Including an MMO file on the CD/DVD, would provide associated metadata, such as artist, publisher and rights information. The manifest in the MVML file could contain the individual



songs, and derived metadata (e.g., duration) would also be available to any CD/DVD player.

This does not need to be restricted only to music; any CD/DVD could potentially contain the MVML file, for example, DVDs and CDs containing commercial video, computer games, and those CDs and DVDs that are provided by magazine publishers as cover disks. If adopted, the format could be recognized by any MVML enabled device.

### **12.2.7.7 Genealogy**

A genealogy application could benefit from creating an MMO for each individual. With the addition of structured tags containing ascendant and descendant links, a dynamic structure could be developed. Images, videos, and relevant biographic information could be stored in a structured way and could be readily shared between genealogy repositories based on the MMO.

### **12.2.7.8 Landscaping asset management**

The MMO model could assist organisations that manage physical assets, such as, trees that may be valuable aesthetically or subject to legal constraints. MVML tags could be extended to include data such as Global Positioning System (GPS) data, and any special information, such as, care or legal data, with the addition of multiple representations such as a variety of seasonal images. By accessing the GPS data an application could be developed to produce mapping information. Including information about how to care for the plant, could allow a maintenance schedule to be established, and using the annotation feature could enable the maintenance to be recorded.

### **12.2.7.9 Equipment hire web site**

To illustrate the other potential possibilities of the MMO structure a commercial hire application could be based on the model. The hire

equipment could be represented by an MMO that could include details of the equipment and also have attached user and repair manuals. The annotation capability could be used to manage events such as the maintenance history. A new piece of equipment could be easily added to the repository by creating the MMO and placing it in the correct folder, and this could immediately become available as a hire item.

The previous discussion illustrated some examples of how the research could be applied to a wide variety of existing situations, and as new technology is implemented many other possibilities will arise.

### **12.2.8 Further investigation**

What things warrant further investigation? When presenting the research one question that surfaced regularly was “Will this be available for ‘us’ to use?”, so investigating how the features identified could be used in existing systems would be worth further investigation.

Three directions are possible for further investigation: to continue designing, implementing and trialling features in the existing prototype; to identify features that could be implemented in existing learning management systems; or to identify features that could be implemented in a way useful to any Web application.

#### **12.2.8.1 Possible extensions to the existing prototype**

If the existing prototype was to be extended what additional features could be added?

One area was highlighted in a student comment received independent of the survey related to annotating a snippet which stated: *“The worry with this type of annotation is that no-one is obliged to pay any attention to it. There seems to be no feedback loop to it to ensure that any suggestions made or*

*links suggested are followed up on. It just seems to fall into the trap of being forgettable post-it notes.*” The implementation of a feedback mechanism such as a track on how many times the annotation (or its link) was viewed, or the inclusion of a request reply check-box could facilitate a better feedback loop. This is consistent with the observations of Graham et al. (2001, Principle 4: Good Practice Gives Prompt Feedback, para. 1) indicating that for online teaching good practice “*instructors need to provide two types of feedback: information feedback and acknowledgment feedback*”.

A second area that lends itself to further research is that of tracking visitor usage. Indeed, this is becoming an important area particularly for companies such as Google where this also assists in improving their search engines. For example, in 2005, Google acquired analysis software, and since late 2007 has been made available as Google Analytics (<http://www.google.com/analytics>). It can be added to existing on-line systems to track visitor usage on any publicly accessible Web site.

### **Tracking snippet use**

From a pedagogical view, the ability to track the use of the snippet by users can provide insights into both the use of the content and the ways visitors navigate the system. For example: managing the footprints will allow students to know what they have accessed and how many times; or reviewing which are the “popular” snippets could highlight difficulties or possible enhancements. In the V/2-Online prototype this was implemented but although the capability was built into the virtualMe prototype a user interface was not developed.

A possible implementation of a snippet tracking display is illustrated in Figure 12-5, and shows both how many times the snippet was viewed and when it was last accessed.

## virtualMe2 – tracking

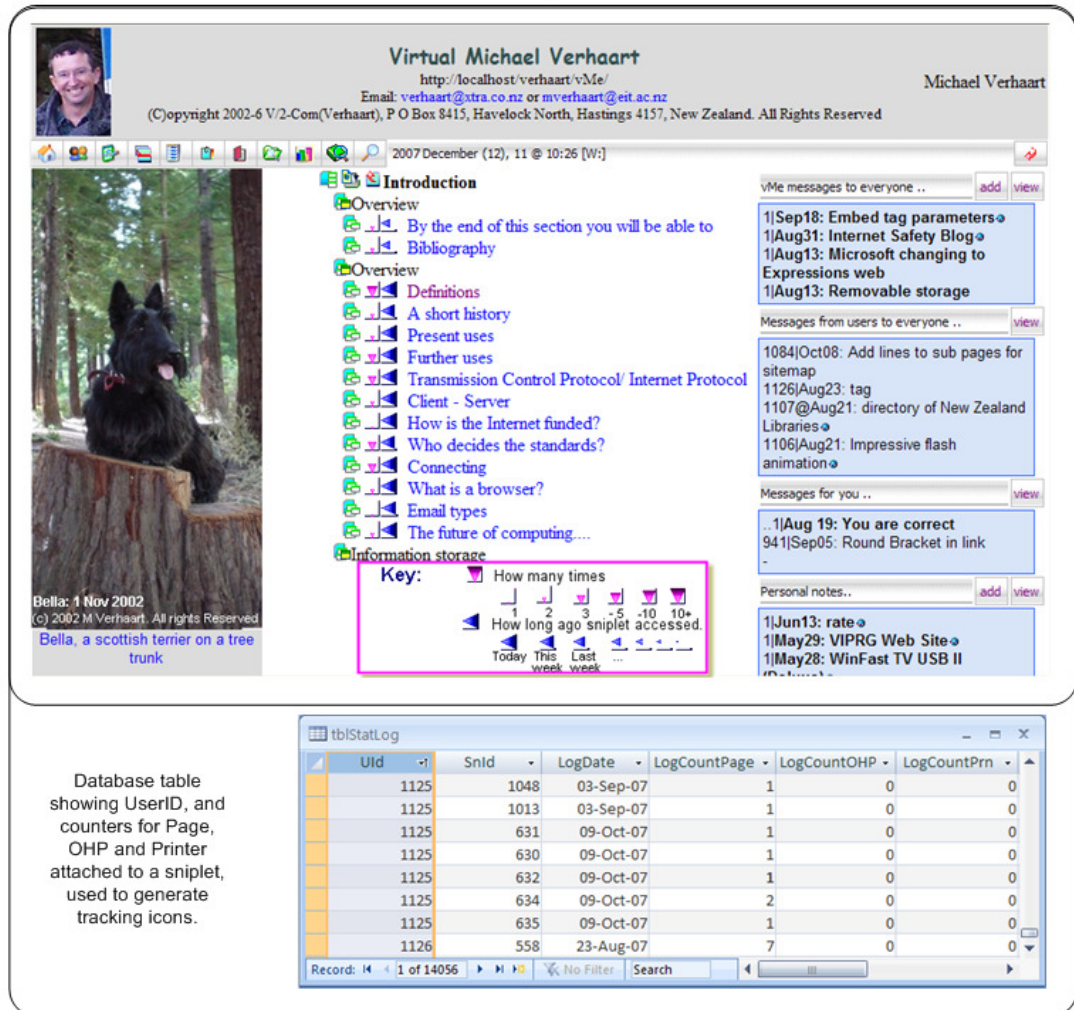


Figure 12-5: Tracking snippet use (last accessed date and the number of times)

### 12.2.8.2 Possible features for consideration in existing LMSs.

Features that could be considered for including into an existing learning management systems (LMS) include:

- The snippet model, with its ability to be displayed in various formats and reusability in different domains.
- The use of wikis to provide feedback, or using a blog structure to emulate the snippet model.

- Developing an integrated annotation capability into an existing LMS, and possibly using an RSS feed to signal that an addition has occurred. As identified in the research, feedback/annotations can be easily overlooked due to the volume of feedback and multiple places they can occur.
- Developing an MMO like capability and designing plug-ins for common Web browsers, such as those used by YouTube for the MMO. Integrating the MMO into an LMS was described by Verhaart and Jamieson (2007).

Personalisation of content is also worth further investigation, as in the survey, relative to other features, personalisation scored lower than the others. For example, the question “the ‘feeling’ that I am interacting with a person rather than content is ...” was perceived by 82% to be useful or very useful. But as Bush and Tiwana (2005, p. 69) found “that personalization only affects stickiness after the knowledge network had established itself”. Hence, further investigation into, whether media elements related to the lecturer/tutor improved the connection with their students, would be useful. This could possibly be tied with investigating whether a Blog with a Really Simple Syndication (RSS) feed would be more appropriate, and this could be included as a plug-in on the introduction page.

A possible extension to the annotation framework is to use it to generate assessment questions. Students could be encouraged to add possible examination questions and indicate this through the addition of a structured annotation type code. Students could then revise by accessing a filtered annotations list showing questions only. From an instructor’s perspective, the questions proposed could form a repository of potential questions suitable for formal assessment.

With the ubiquitous nature of the cell phone and its ability to send SMS (text) messages, an interesting research project would be to investigate the feasibility of allowing annotations to be added to the site as text messages.

Each snippet could have a unique identifier that is displayed in class and students could text annotate during class. This would provide some interesting research into the use of mobile technologies in the classroom.

### **12.2.8.3 Possible features for consideration in Web systems**

The ability to view a Web page in overhead view could also be generalized. For example, a pop-up window could be included as an add-in to a Web browser that displayed just the headings in the page and the level could be user selectable. Additionally images could be displayed as thumbnails and enlarged when selected. This would be very useful when using Web pages to be displayed to a large audience.

In the research, numerous Web pages were referred to, and to create a reference and citation in a recognized style, such as APA, was time consuming. Considerable time could be saved by researchers if it were possible to include the metadata with the document that could automatically generate a referencing format. A plug-in could then be developed that would automatically produce the associated referencing and possibly the citation string.

### **The multimedia object**

The usefulness of the multimedia object (MMO) as a way to present media could be developed as a plug-in, in a similar way that YouTube videos can be included in existing online systems such as blogs and social software. Or as an alternative, a system to manage the MMOs could be developed as an add-on that would provide functionality to create, add, aggregate, manage and view MMOs as part of the system and provide the functionality to allow for the sharing of MMOs with other systems.

An area which would produce benefit to a large number of Web users is in developing the MMO into a single file, probably as a zip compressed file,

with an html object “plug-in”. The design and possible implementation was described in Verhaart and Jamieson (2007). Use of MMOs could address some accessibility issues, for example, a blind person could set up his/her system so that all graphics were replaced with audio equivalents.

Developing repositories for MMOs and snippets, in a way similar to Flickr or YouTube would also be another area for future research and development. Access to these repositories could be via a Web service and this would allow MMOs or snippets to be attached to applications such as LMSs, blogs or custom applications (Figure 12-6).

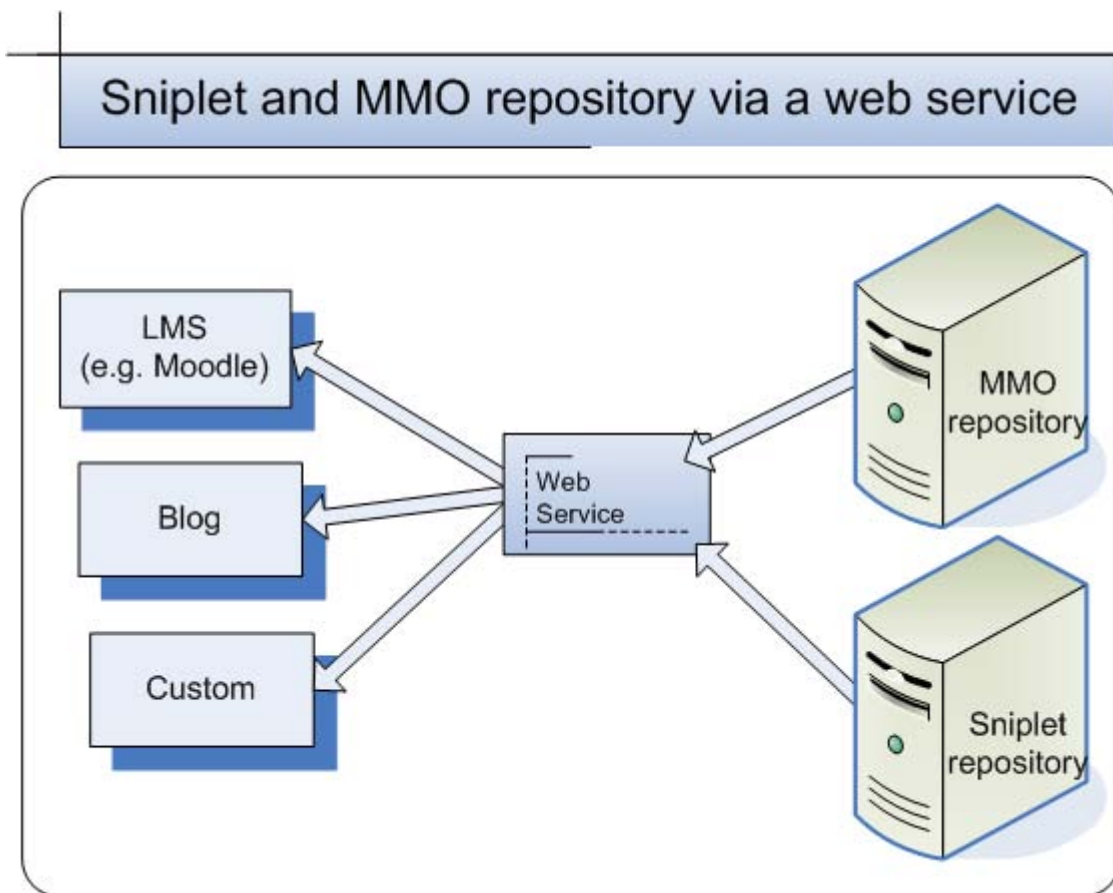


Figure 12-6: Tracking snippet use (last accessed date and the number of times)

There are still many future research opportunities for the MMO, such as: evaluating emerging and evolving metadata implementations to assess whether they will be able to accommodate the MVML based MMO; normalizing the data structures within the MMO/MVML model and

removing the multiple namespaces with the intention that XSLTs will be used to transform the MVML XML to the desired structure.

## **12.3 Conclusion**

Reflection and integration is the final stage in this thesis, where findings are considered with regard to how they can be integrated into new or existing frameworks, structure, models or systems.

Discussion on how the findings could impact on teaching and learning, included the integration of the snippet model, and consolidation of annotations. Also covered was the issue of how the methodology evolved into a cyclical phase between reviewing the field of study and theory building, and the advantages of using a prototyping methodology to cope with a continually evolving technology.

This continual change also affected both the researcher and students as new and innovative applications were appearing regularly, and included a significant trend into online social networking. While conducting the research, collecting user emails as they accessed the system was found to be very useful, as in institutional systems they were generally only available while the students were enrolled.

Performance was one issue seen by users as significant and the use of a local or national Web host was one way in which this could be addressed.

Developing a customized solution as opposed to using existing systems was both an advantage and disadvantage. The custom solution meant features could be easily added, but it did mean that the actual application could not be “rolled” out to users. Using existing systems would have caused problems in both trying to add features into an institutional system which is under tight control, and due to the length of the research, ran a risk of being changed, as was the case.



A list of existing applications that could benefit from the research was discussed and included applications in: teaching and learning, content management, physical (e.g., hire centre, or landscaping) and electronic (e.g., photo-gallery, or business contacts) asset management, and bibliographic management.

Three directions for further investigation were identified: extending the custom prototype, adding features to existing applications (such as, LMSs) or extending existing Web technologies (such as, add-ins to Web browsers). These included: adding visitor tracking data, adding a snippet or MMO, or developing referencing functionality.

## 13 Conclusion

Based on the initial observation that in a teaching and learning context students hold information and knowledge that could be useful to include in course content, the initial aim of this research was to develop a metadata schema to capture information and knowledge at source in context. The overall research question initially was summarised as:

*Can a framework be developed to acquire contextualized information and knowledge that may exist in a variety of data types, at source?*

In Chapter 1 this was refined into a set of problem statements (Table 1-1). The following sections summarise the thesis findings relative to the problem statements, and Table 1-1 has been separated into Table 13-1, Table 13-2, Table 13-3, and Table 13-4.

### 13.1 virtualMe framework

Table 13-1: Problem statements with overall framework

		Methodology
1.	Overall framework	
	<i>What features are desirable in a framework that allows for the acquisition, management and sharing of an individual's information and knowledge that may exist in a variety of data types, at source in a teaching and learning environment?</i>	
	<ul style="list-style-type: none"><li>• <i>Develop a list of features.</i></li></ul>	Literature review and prototypes
	<ul style="list-style-type: none"><li>• <i>Investigate perceived usefulness.</i></li></ul>	Survey

Knowledge is considered to be “*what is known by an individual*” (Goppold, 1996), and there are many ways in which it can be acquired. As stated by

Meisenberger and Seiwald (2002, p.10), *“Only a small part of individual knowledge is generated through the process of individual experience. Most parts are socially derived”*. Hence, this emphasises two conditions, first that knowledge is based on an individual, and second that other people contribute to adding to this knowledge.

Three knowledge types were identified as central to this thesis: tacit (*“We know more than we can tell”* (Polyani, 1966, cited in Nonaka, 1994, p. 16)); explicit (That which can be written down); and missing (What we should know to complete our work (Davidson & Voss, 2002)).

The importance of developing a knowledge acquisition system is highlighted in the comment *“much of any organisation’s experience and expertise remains underused and underexploited simply because it resides not in databases, repositories, or manuals but in the minds of its employees”* (Bush & Tiwana, 2005, p. 67). This is true in an academic sense, where providing a mechanism to capture an individual’s information and knowledge will greatly assist in distributing a persons experience or expertise.

The results of the research produced the virtualMe framework, and encapsulated the ideas that knowledge is centred on an individual, and that much is socially derived (annotation capability). The architecture of the virtualMe framework is illustrated in Figure 13-1.

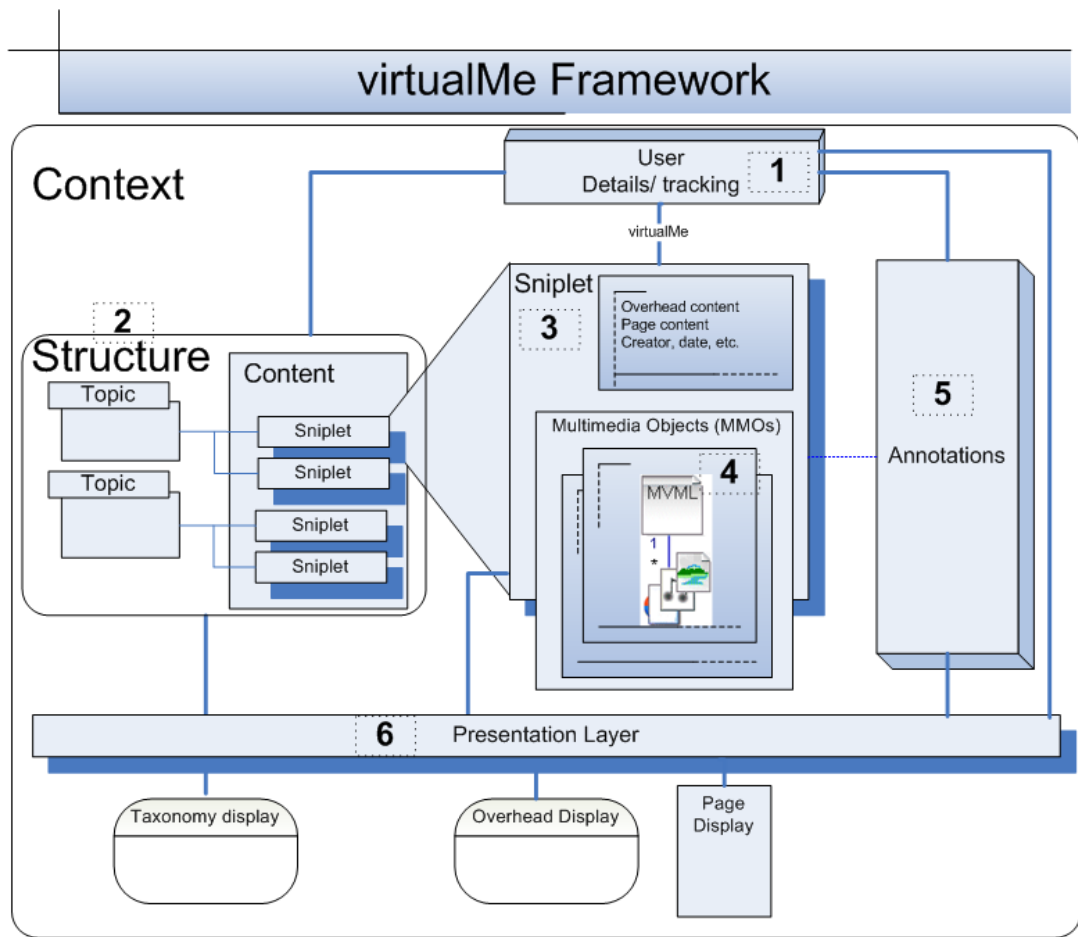


Figure 13-1: virtualMe framework architecture

The framework has been described in detail in Chapters 6 and 7, and includes:

1. a user management sub-system, to control access and tracking details;
2. a taxonomy structure, to organise the content;
3. a snippet model to store the content;
4. a multimedia object (MMOs) model with associated metadata described in the multimedia vocabulary markup language (MVML);
5. an annotation framework to manage sharing of information and knowledge and allow for both out-of-context and in-context comments to be managed; and
6. a presentation layer to manage the user interface.

The framework was implemented and validated through a series of Web based prototypes, and was trialled on student groups in a blended teaching and learning environment. The feasibility of the framework was further supported through publications and presentations in peer reviewed journals, books and conferences.

A survey was undertaken to determine the perceived usefulness of the framework, with participants using the final virtualMe prototype as a basis for their comments. Perceived usefulness of the features, such as snippet presentation and reusability, referencing information, and social structure surveyed exceeded 82% in all cases when useful or very useful were combined. Combining the summative data with the comments revealed that presentation, reusability and navigation rated highly, and by comparison personalisation and social structure were rated as less important. The issue of cognitive load was raised as the prototype displayed a significant amount of information on a single screen.

Based on the research a comprehensive summary of desirable features was compiled that could provide a basis for best practices when developing, implementing or using new or existing Internet based teaching and learning systems in a blended environment. Features were described in Chapter 11 and were classified as follows:

- Content.
- Teaching and learning
- Resource acquisition, management and sharing at source
- Acquisition of information and knowledge (Annotation)
- Learning / content management system
- Miscellaneous features.

The virtualMe framework has been contextualized in a teaching and learning environment and two significant outcomes of this thesis are an

annotation framework, and a model for representing multimedia objects. Conclusions from the research are described in the following discussion.

## 13.2 Annotation framework

Table 13-2: Problem statements with annotation framework

		Methodology
2.	Annotation framework	
	<i>What features are desirable in a framework that would enable other people to add information and knowledge that will benefit all users of the system?</i>	Literature review and prototypes
	<i>In the virtualMe which annotation features are perceived to be useful?</i>	Survey

As mentioned previously, “most knowledge is “*socially derived*” (Meisenberger & Seiwald, 2002, p.10). An information and knowledge system needs to be able to manage the process of knowledge production, firstly to facilitate the tacit to explicit knowledge spiral (Nonaka, 1994), and secondly to allow for missing knowledge to be acquired. The virtualMe framework supports the tacit to explicit conversion (Nonaka, 1994) by providing mechanisms for socialisation (e.g. face-to-face teaching support), externalisation (e.g. online discussion), combination (e.g. online course notes) and internalisation (e.g. facility to study online content). Further, the framework provides support for the observation by Lewis (2002), that groups are able to gather and synthesise information and knowledge more quickly than an individual.

As Web technology matures, annotation capabilities are being progressively built into existing Web sites as a way to gather feedback from users. In this thesis, an annotation was defined as “*a comment added to an online system by a visitor*”. Initially out-of-context feedback was collected via email and bulletin boards, but in-context annotation capabilities have appeared, such

as, for asking feedback on programming issues (Adobe's LiveDocs) and current events (NZ Herald).

The virtualMe framework contains an integrated structure that allows for both in and out of context annotations, in which information and knowledge can be acquired, managed and disseminated from and to users. The annotation framework associated with the virtualMe was described in Chapter 6 and is illustrated in Figure 13-2.

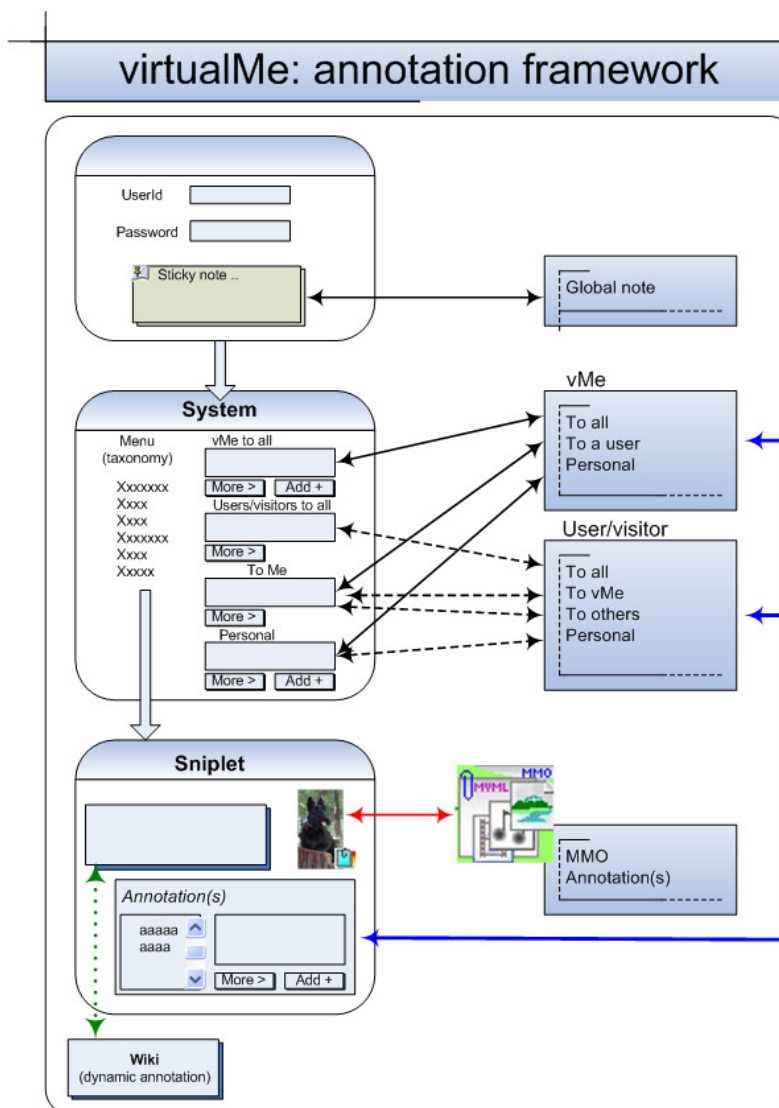


Figure 13-2: virtualMe annotation framework architecture

Features of the virtualMe annotation framework include:

- global comments to notify all users before logging in;

- annotations that can have different viewing permissions, such as, public, directed to a specific user, or personal;
- annotations that can be created at a system level (out-of-context) to allow generic comments;
- annotations that can be added to a snippet (*should* be in-context);
- annotations that can be added to an existing annotation (a thread);
- the ability to clone content and allow user modification (similar to a wiki);
- annotations that can be added to a multimedia object;
- annotations that are created in date-time order (functionally similar to blogging); and
- the capability to consolidate all annotations in one place in the system.

Several annotation type were identified, out of context (e.g. email), threaded (e.g. bulletin board), in-line structured (wiki), and in-context (attached directly to content). The virtualMe framework has mechanisms that allow for all these annotation types to be integrated and managed in a single consistent environment. As far as can be determined, this facility has not been implemented in any other content or learning management system.

One issue identified was that annotations are typically textual. Although the virtualMe framework annotation system could be extended to manage multimedia annotations through users creating MMOs, this facility was not implemented, and would be an area for further research.

The literature review identified that Likert scales could be used to comment on the usefulness of content. This capability was not implemented in the virtualMe prototype as, although it was implemented in the V/2-Online prototype the feature was seldom used. With this feature becoming more common on the Internet this would be an area to be monitored in the future.



How annotations related to Chickering and Ehrmann's (1996) "seven principles of good practice" was discussed highlighting the annotations ability to provide mechanisms to encourage faculty and student contact, cooperation among students, and prompt feedback.

In the user survey, at least 92% of the respondents indicated that an annotation feature was perceived to be important (useful or very useful), though in the written comments an observation was made that it was "*nice to have the option*" though wondered "*how often this would be used*".

### 13.3 Resource acquisition, management and sharing at source: MMO

Table 13-3: Problem statements with resources

		Methodology
3.	Resource acquisition, management and sharing at source	
	<i>"What features are desirable in an electronic digital asset model that has the ability to retain context while transferring the content from one person to another and from one place to another?"</i>	Literature review and prototypes.
	<i>"The virtualMe framework introduces the MMO model to manage digital assets. Which features are perceived to be useful by users?"</i>	Survey

A significant outcome of this research is the development of the multimedia object (MMO) model. This has been discussed in detail in Chapter 8 and the model is illustrated in Figure 13-3 and architecture in Figure 13-4.

## Multimedia object (MMO) model

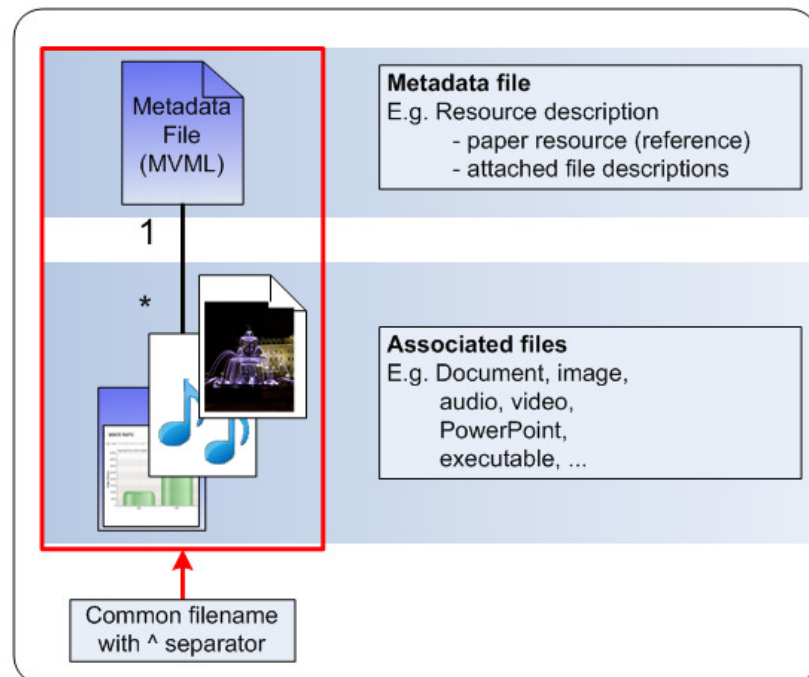


Figure 13-3: Multimedia Object (MMO) Model

The complete MMO is made up of an MVML file and associated media, and this can be interpreted by a computer based application to generate an appropriate screen display. Using extensible Style Language (XSL) transformations, the metadata can be used to generate suitable schemas for existing standards such as Dublin core, APA referencing (and others if the XSL is developed), xCard, and EndNote.

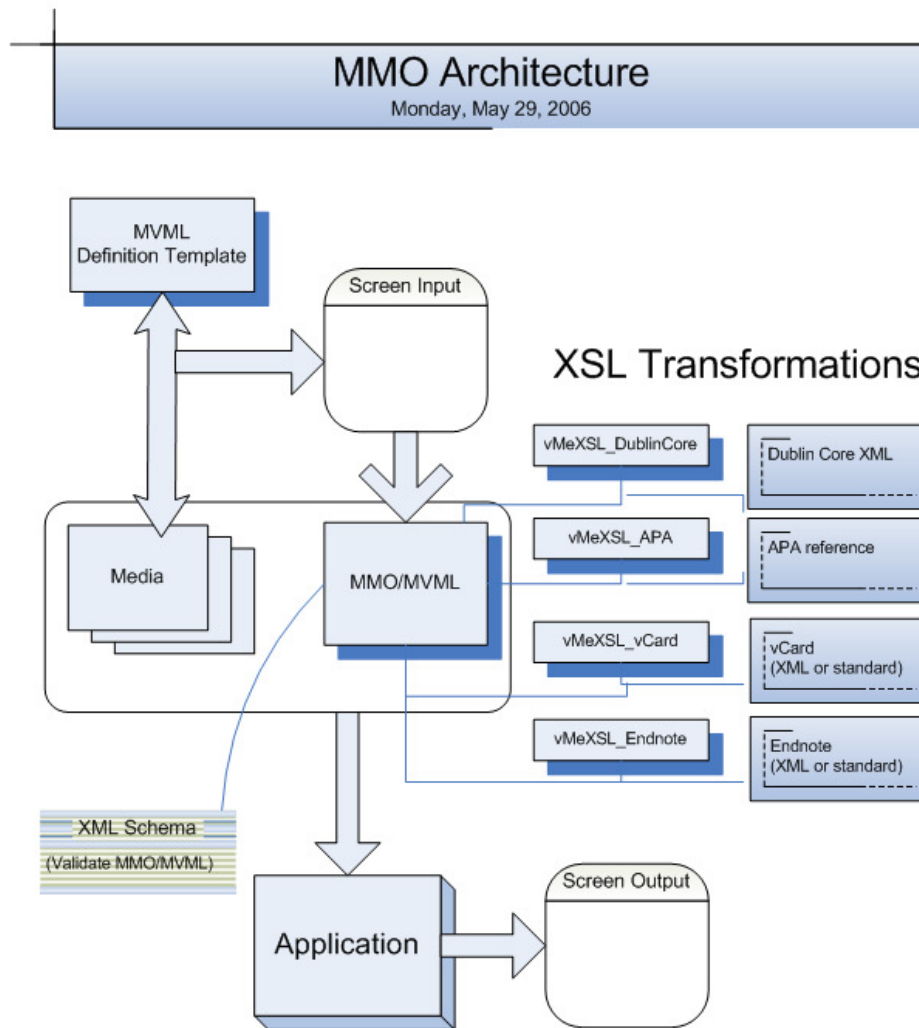


Figure 13-4: MMO Architecture

The MMO has the capability to:

- be used for: existing, legacy and future media formats;
- represent a media object in many ways;
- provide a standard way in which to attach metadata (MVML);
- retain the context of any media element when transferring from one person to another or one place to another;
- allow re-aggregation of a media element through the use of a meaningful naming convention; and
- allow a user of the MMO to customise the metadata so that it incorporates their knowledge, but retains the original contextual information.

Associated with the MMO, is an XML file using a metadata language (MVML) that was developed to describe the media object and contain the manifest of attached files. The MVML structure includes: standard metadata types (Dublin Core, vCard,); is structured using the W3C's Resource Definition Framework (RDF); contains derived metadata to assist in Internet rendering; has the capability to be annotated; and has the capability to generate a standard APA reference, and an EndNote reference for a multimedia digital asset. This multimedia object is a structure unique to this research.

In addition a template script was developed to allow for the automatic creation of forms to assist in the creation of the metadata for the digital assets MVML file. This is a generalised scripting template and is suitable not just to create automatic forms for MVML, but for any XML file with the embedded template language. This too is unique to this research.

The literature review also identified criticism levelled at metadata creation as the “*need for considerable human input*” (Phillips, 2000, p. 494), and unless the creation of the metadata provides a real benefit this will not occur (Phillips, 2000; Goldfarb & Prescod, 2002). Real benefits exist as the metadata is automatically integrated with the content, for example includes the ability to provide automatic alternate text and captioning text, media height and width (to improve browser rendering), and referencing information.

Uniqueness of a digital asset was also identified as a problem in the literature review. A simple file naming convention was proposed consisting of a date, author, description, caret (^) separator, media use (e.g. print, screen), and the file extension (e.g. 2008Verhaart\_Finland^prn.jpg). Using this structure greatly simplifies the generation of a unique filename, as it does not require registration in a global database (such as, the Digital Object Identifier (DOI) system), allows for re-aggregation should one of the elements be separated (as the filename is not numerical), and is human

readable (the filename gives some clue as to the contents). This too is unique to this research.

## 13.4 Teaching and Learning

Table 13-4: Problem statements with teaching and learning

		Methodology
4.	Teaching and Learning	
	<i>What features are desirable in a blended (online and face-to-face) teaching and learning environment?</i>	Literature review and prototypes.
	<i>“What benefits does the virtualMe framework provide for teachers and learners?”</i>	Survey

Wade and Power (1998) stated that the World Wide Web provides many advantages for courseware delivery, such as: the ability to overcome data and platform incompatibilities, provide a consistent interface and search facilities, and integration of multimedia and interactive content. They further list eight general requirements for WWW based instructional design.

How well does the virtualMe framework match these requirements? The virtualMe prototype illustrated the capability to incorporate interactivity and multimedia by including multiple representations of learning activities through the MMO model, and the ability to use of video and support Flash movies (which can be highly interactive and support simulation and experimentation). The use of the technologies students were learning about (Internet and database) motivated them in understanding the relationship between the theory and the actual application of that theory. Collaboration through annotations was provided, and the human computer interface was deemed by most in the survey to be easy to use (in excess of 83% finding the overall prototype easy or very easy to use). Technical issues were

problematic at times, but overall these were not seen as a significant obstacle. Finally, through the taxonomy structure content was organised logically in domains.

Hiltz and Turoff (2005) identified that students preferred different environments, face-to-face, online, or hybrid, and identified different pedagogical concepts appropriate for each, that is, for f2f, objectivist and teacher-centred; and online and hybrid (or blended) courses using digital technologies such as constructivist, collaborative, and student-centred. The virtualMe framework was designed to support both face-to-face (f2f) and online delivery and provided features to support all three modes.

The virtualMe includes structures for face-to-face and online teaching, and it was important that consideration was given to supporting good teaching practice. In terms of Chickering and Ehrmann's (1996) "seven principles of good practice" related to teaching and learning, the virtualMe provided the capability to use active learning techniques through its multimedia capability, provided an online solution to assist time on task, and supported a wide variety of delivery techniques including, overhead discussion display, a workbook feature, and multiple representations of multimedia elements. The annotation capability addressed the principles also and was covered earlier.

The literature review also identified the importance of learning objects as a way to reuse content. Internally the snippet and MMO are mechanisms that allow for reuse of both content and media. If an MMO were packaged as a zip file this would greatly facilitate their reuse, and this was identified as an area for future development. Packaging snippets into one of the many learning object formats is feasible and indeed this was illustrated in the capability to produce a static version of the content. The down-side of packaging for another system is the loss of the interactivity.

As the research was conducted in a teaching and learning environment it is important to consider the benefits of the virtualMe framework. and could

form the basis of best practice considerations in a blended teaching and learning environment. Where surveyed the feature list developed and described in Chapter 11 generally achieved a rating of in excess of 80% for perceived usefulness. The main features of the virtualMe framework as related to teaching and learning include:

- a structured taxonomy, (the capability to provide structure to the content);
- the snippet model, (a content chunk equivalent to one overhead);
- the use of the multimedia object (allowing multiple media representations, and an ability to automatically create reference information, e.g. APA); and
- an annotation framework (allowing consolidation of out-of-context and in-context comments).

### **13.5 Other areas for future research**

The research presented in this thesis provides many opportunities for further exploration, for example:

- Whether the knowledge system could be extended so that the system itself could create new “knowledge”? That is, since the system contains knowledge of an individual, could it be used to aggregate this knowledge and present it in a different form?
- Whether the knowledge system could be used to mine the knowledge the students’ possess, as a human lecturer would do?
- To develop Web agents that could be attached to the virtualMe systems. For example, a question could be entered as an annotation in one virtualMe system, and could then be passed through to the Web agent. This agent would determine if there is a locally available answer, and if not, connect to other virtualMe that deal in a similar domain. This is synonymous with a lecturer being asked a question, who being unsure of the answer asks a colleague.

- Whether the features developed in the virtualMe framework could be adapted to existing content or learning management systems. For example, the implementation of the snippet/MMO structure as an add-in to Moodle.

## **13.6 Difference between this research and the development of an application?**

Information technology by its very nature is focused on using technology, and as such it would be expected that an electronic artefact would be created to validate the research. Developing standards such as metadata would have little relevance if there was not technology to support the use of it.

When developing a computer application, the application itself is the focus. The user interface is a key component and considerable user testing, including extensive error trapping, needs to be done. In building a research artefact, the user interface can be sacrificed to functionality. In the case of virtualMe there are many areas that need further development in order to bring the software to a user application level. The most obvious area is in the creation of the MMO. While the system allows for its creation, it is unlikely that an end-user would find the current implementation suitable, but the functionality to produce and demonstrate the features of an MMO is there.

## **13.7 Conclusion**

At the start of the thesis it was stated that the motivation for the thesis was that students had information and knowledge that would be useful to the lecturer and often this was lost. After conducting the research, has this problem been addressed? The virtualMe framework which includes the



multimedia object model and annotation framework allows this information and knowledge to be captured in and out of context.

From a theoretical view point the initial statement was to “develop a metadata schema for divergent data types to be acquired at the source”. This has been addressed via the snippet model and the MMO model.

This research produced three significant outcomes: the virtualMe framework, an annotation framework, and the multimedia object (MMO).

The virtualMe is a framework that provides an environment to acquire, manage and disseminate information and knowledge. The focus of the framework is on an individual rather than content which is typical of today’s modern learning management systems (e.g., Moodle, Blackboard), and is in keeping with the trend to social networking systems emphasized in Web 2.0 (e.g., Bebo, MySpace). In these systems control and ownership is by an individual with the opportunity for others to participate.

The MMO is a metadata package that allows the acquisition of media objects (including legacy objects), in a way that useful information can be derived, and that the original context is maintained.

This thesis developed a framework and models that provide the ability to retain context while transferring the content from one person to another and from one place to another. The virtualMe framework retains the original context and then allows the receiver to customise the content and metadata so that the content becomes that person’s knowledge. A mechanism has been created for such contextual transfer of content (context retained by the metadata) while enabling multiple representations, using MVML. MMO is the basis for that.

At present there does not appear to be another standard mechanism allowing this contextual transfer which could help in creation of knowledge

for one person while still retaining the original context. This is a unique and important strength of the study.

The annotation framework highlights the possibilities for information and knowledge capture particularly where this is integrated and interwoven with the content. This too is unique to this study and as yet a fully integrated annotation capability has yet to appear in any existing teaching and learning system.

The virtualMe framework and the enabling technology, in the form of MVML (with MMO as basis), and a fully integrated annotation framework, and is a unique and important contribution to the body of knowledge. The findings of this research have been extensively published in peer reviewed journals, as book chapters, conference proceedings and presentations.

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## Appendices

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### **A      Glossary of terms and definitions**

Some of the definitions were published in:

Verhaart M., & Kinshuk (2006). A dynamic personal portfolio using web technologies. In C. Ghaoui (Ed). *Encyclopedia of Human Computer Interaction*, pp 170-174, ISBN: 1-59140-562-9, Idea Group Reference

#### **Abbreviations**

**CMS:** Content Management System

**DCMI:** Dublin Core Metadata Initiative

**f2f:** Face-to-face, for example, a lecture.

**HTML:** Hypertext markup language

**IEEE:** Institute of Electrical and Electronics Engineers

**IFETS:** International Forum of Educational Technology and Society

**ISO:** International Standards Organization

**LMS:** Learning management system

**LO:** Learning object

**LTSC:** Learning Technology Standards Committee

**MMO:** Multimedia object

**MVML:** Media vocabulary markup language

**NACCQ:** National Advisory Committee for Computing Qualifications

**RDF:** Resource definition framework

**RSS:** Really simple syndication

**XML:** Extensible mark-up language

**Blended Learning:** A mixture of eLearning and Face-to-Face (F2F) learning. See also: eLearning.

**Content Management System (CMS):** A computer based system that manages content. It is part of a learning management system.

**Digital Asset:** An electronic media element, that may be unstructured such as an image, audio or video, or structured such as a document or presentation, usually with associated meta-data.

**Dublin Core Metadata Initiative (DCMI) Metadata Element Set:** A set of 15 meta-data fields, for example, title and author, commonly used by library systems to manage digital assets (all fields are optional).

**eLearning (electronic learning, computer enhanced learning):** Learning supported by electronic, commonly web based, technologies. See also: Blended learning.

**Institute of Electrical and Electronics Engineers (IEEE):** A non-profit professional association for the advancement of technology (<http://www.ieee.org>).

**International Forum of Educational Technology and Society (IFETS):** An online discussion forum, which is a global network of educators and practitioners in distance education and electronic learning technologies.

**International Standards Organization (ISO):** responsible for the ISO 9000 and other international quality standards. <http://www.iso.org>.

**Learning Management System (LMS):** A computer based application used to support learning. It includes a content management system plus various features to manage course structures and student assessments. Examples include Moodle, Blackboard and WebCT.

**Learning Object (LO):** An artefact or group of artefacts with learning objectives that can be used to increase one's knowledge.

**Learning Technology Standards Committee (LTSC):** A committee chartered by the IEEE Computer Society Standards Activity Board to develop internationally accredited technical standards, recommended practices, and guides for learning technology. (<http://ieeeltsc.org/>)

**Media Vocabulary Markup Language (MVML):** An XML based language that describes a media element.

**Meta-data:** Commonly referred to as *data about data*. For example, a digital asset has meta-data which would include the derived data (size, width) and annotated data (creator, description, context).

**Multimedia object (MMO):** A self describing manifest of files used to encapsulate an electronic media element. It consists of media files conforming to a defined naming standard and an associated MVML file.

**Multipurpose Internet Mail Extension HTML (MHTML):** A file format that allows both html and associated objects (such as images) to be embedded in a single file. Was included in Internet Explorer 7, released in mid 2006. All relative links in the Web page are remapped and the embedded content is included in an .MHT file.

**National Advisory Committee for Computing Qualifications (NACCQ):** A forum of Polytechnics, Institutes of Technology and some Universities in New Zealand. <http://www.naccq.ac.nz>.

**Really Simple Syndication (RSS):** An XML based format for sharing and distributing Web content that is changing or being added to often, such as blog posts and news. Using an RSS reader feeds are aggregated, so that a user can be informed when a change or addition has occurred without the necessity to continually check on the source.

**Resource Definition Framework (RDF):** Part of the Semantic web, and is a way to uniquely identify a resource whether electronic or not.

**Snippet:** A piece of knowledge or information that could be represented by one overhead transparency.

**vCard:** A meta-data format that enables a person's personal information (such as contact details) to be described. This is used extensively in commercial email systems and can be thought of as an electronic business card.

**Virtual Me:** A framework that uses internet technologies to structure a personal portfolio and allows external users to add annotations. A snippet is its basic unit and digital assets are structured as multimedia objects (MMOs).

**Web log (blog):** An online diary typically authored by an individual, where unstructured comments are made that can be annotated by visitors.

**Wiki:** A publicly modifiable bulletin board, where anyone can change the content, but generally with features so that changes can be un-done. The term is derived from "wiki" meaning "quick" in Hawaiian, and was coined by Ward Cunningham in 1995.

## **B           Media   Vocabulary   Markup   Language (MVML) Template Script**

### **B.1           Introduction**

In this research, media vocabulary markup language (MVML) was developed, which describes the metadata of an object. This language:

- conforms to existing standards;
- manages derived information such as file name, type and size; and
- manages annotated information, including:
  - the contextual information such as situational data;
  - creator information;
  - bibliographic information; and
  - additional annotation information that may be added later when the digital asset is reused.

A criticism often leveled at metadata is the need for considerable human input, and unless it is perceived to be useful and time efficient, in many instances metadata is not created (Phillips, 2000, pg 494; Goldfarb & Prescod, 2002). This could be streamlined if some metadata could be inherited, for example, for original cartoons, author details, rights information, and some of the keywords would be common. In the prototype this was managed by placing related files into a folder with a template (modified from the generic template) that could be used to generate the MVML metadata file.

This appendix defines the structure of the template and its syntax.

### **B.2           MVML   Template   folder   master:   XML Template Generator (XTG)**

Using an MVML file an application can build an XML metadata file, insert derived values, create fields on a form for user entered data, and

automatically fill in default data. By design, the MVML instructions are placed between the XML tags and always begin and end with a "^". The XML template generator (XTG) is built around two basic constructs: the XTG replace, and XTG tuple.

### B.2.1 XTG Replace statement

A derived value is one which can be automatically generated by a computer and does not require human intervention. In the MVML file it is represented by a replace code and has the form "^tag;^". When the object's MVML file is created these tags can be automatically replaced by the appropriate data. Examples of derived values include today's date, the name of the file, and so on. Table B-1 lists valid XTG codes.

Table B-1: List of valid XTG replace codes with their derived values

Code	Description	Format	Example
^D;^	Today's Date	yyyy/MM/dd	2008/03/25
^Fdr;^	Folder (from root)containing this mvml file (note does not end with "/" )	<folder>	db/vMe_bella/buscard
^sysHttp;^	http url of web site (note ends with "/" )	<http home url>	http://www.virtualmv.com/
^D:mmmdd;^	Todays date (month day)	MMMM dd	August 12
^D:yyyy;^	Todays Date (year)	yyyy	2008
^M;^	MVML filename	<file>.mvml	xyz.mvml
^ds;	File size	Bytes	8030
^dw;	Derived Image/video width	pixels	800
^dh;	Image/video Height	pixels	600
^dd;	Audio.video Duration	hh:mm:ss	00:01:30
^vMe;^	Family name, initial	<family name>, <init>	Verhaart, M (from vMe/vMe_Community.xml)

Derived values should be replaced when an MVML file is initially created to ensure that these values are displayed correctly on the form. .

Two examples of using replace codes for substitution with derived values are as follows:

```
<mvml:accessYear>^Access Year [#MBYA;]|^D:yyyy;^|Enter year
  accessed^</mvml:accessYear>

<mvml:shortdsn>^short description|30+#T;|for
  ^fn;^^</mvml:shortdsn>
```

In this example, there are two replace codes for derived values: ^D:yyyy;^ for year and ^fn;^^ for a filename. These would display on a form as shown in Figure B-1:

Figure B-1: Form showing replaced values substituted with derived values

Once processed by an MVML generator could become:

```
<mvml:accessYear>2008</mvml:accessYear>
<mvml:shortdsn>Maraetotora waterfall</mvml:shortdsn>
```

### B.2.2 XTG Tuple statement

A tuple allows three parameters to be passed to the XML generator from the template, and takes the form “*Label for control | Contents | Help*”. Each parameter is separated by the “|” character and every tuple **must** have 2 separators.

For example, given the following tuples (and the date replace), the data entry form shown in Figure B-2 can be generated.

```
<dc:date>^D;^</dc:date>
<dc:title>^Title[*]|20|^</dc:title>
<dc:subject>^Subject|15+Finland, ICALT 2004|Enter keywords
  separated with a comma^</dc:subject>
<use>^choice|original[icon::thumbnail::con::prn::]|Use
  type^</use>
```



Figure B-2: Sample of a data entry form for meta-data values

Help is shown as a comment on the right of the form object, but it is expected that the help would be implemented in a way that would be consistent with the application hosting the generator, for example, help could be shown via a help bar at the bottom of the screen, or as a pop-up tool-tip when the mouse is over the control.

### B.2.3 XTG Format and examples

Each value in the XML file that requires the template is represented by the XTG Tuple, as follows:

`^<label> | <width>,<rows>+<default/selection> | <help>^`

- width, rows are optional (and + may be left out) and help is optional.
- <default/selection> can be blank or contain an initial value

#### *Example 1: Specifying a text entry field*

```
<vCard:Country>^Country|20|^</vCard:Country>
```

#### **Comments**

Here a blank text box labeled Country is displayed. The width of the text box is 20 characters. No help is displayed.

***Example 2: Specifying a text entry field with initial contents and help***

```
<dc:subject>^Subject|30+Finland, ICALT 2004|Enter keywords  
separated with a comma^</dc:subject>
```

***Comments***

Here a text box labeled Subject is displayed, containing "Finland, ICALT 2004", and with the help comment "Enter keywords separated with a comma". The width of the text box is 30 characters.

***Example 3: Specifying a mandatory field***

```
<dc:title>^Title[*]|30+|^</dc:title>
```

***Comments***

Here the [\*] after the Title label is used to signify a mandatory field. The second parameter indicates the width of the text box as 30 characters and gives a blank content entry and no help is displayed.

***Example 4: Creating a text area field***

```
<dcterms:abstract>^Abstract|40,4+|^</dcterms:abstract>
```

***Comments***

Here text area labeled Abstract of width 40 characters and 4 rows is created.

**Example 5: Providing additional information in a text box**

```
^subtype|basic{gif,png,jpg,jpeg}|^
```

**Comments**

Text placed in {} will not be saved into the XML file. Here a text box titled subtype is created. In the contents "basic{gif,png,jpg,jpeg}" is inserted. When saved, the portion of the string in {} is not stored in the XML file.

**Example 6: Standard drop box**

```
<use>^choice|original[icon::thumbnail::con::prn::]|Use  
type^</use>
```

**Comments**

Here a drop box titled choice is created. The default value is original, and when the drop box is selected, original, icon, thumbnail, con and prn are available choices. A help comment "Use type" is displayed. The drop box will be displayed at the width of the longest element in the list so the width value does not need to be specified. Note the use of a : prior to the ], which means that a blank or user defined value can be entered (not just the values in the list)

A double colon delimiter is used to allow values containing a colon (:) such as a url (e.g. http://www.mysite/com) to be an acceptable choice.

**Example 7: Drop box with edit text box**

```
<use>^choice|[[icon::thumbnail::con::prn]]|Use type^</use>
```

**Comments**

To create a drop box called choice, as well as a text box, "[[" and "]" are used in the middle definition. Once the drop box value is selected

this is copied to an editable text box. The editable box is then copied to the MVML file. If no value is selected from the drop box a value can be directly entered into the text box. This was not implemented in the prototype and is included for future reference.

### ***Example 8: Providing additional information in a drop option***

```
^subtype|[plain{txt}::html{htm,html}::rich text{rtf}]|^
```

#### ***Comments***

Here a drop box is created displaying the three options (plain, html and rich text) in the drop box the portions in {} are also shown. On saving to the XML file only plain, html or rich text is stored.

## **B.2.4 Reusable entries**

As meta-data entries can be duplicated a mechanism to replicate values is needed. In the XTG the "#" symbol indicates that the value entered may be used elsewhere in the template. This is particularly common in vCard where a name is represented in a variety of ways.

### ***Example 9: Reusable coding***

```
<dc:creator>#F;, #I;, #P;</dc:creator>
<vCard:FN>#F;, #G;, #P;</vCard:FN>
<vCard:N rdf:parseType="Resource">
  <vCard:Family>^Family Name[#F;]|30+|^</vCard:Family>
  <vCard:Given>^Given Name(s) [#G;]|30+|^</vCard:Given>
  <mvm:Initials>^Initial(s) [#I;]|30+|E.g. M.H.^
  </mvm:Initials>
  <vCard:Prefix>^Prefix[#P;]|
  [::Ms::Mr::Mrs::Dr::A/Prof::Prof]|Eg. Ms, Mr, Mrs,
  Dr^</vCard:Prefix>
</vCard:N>
```

#### ***Comments***

Here four duplicate fields are defined in the label portion of the tuple. (#F;,#G;,#I; and #P;). The fullname (FN) is then made up of the family

name followed by the given name, then the prefix. Notice that the full name field has no label and that the replace values are not delimited by ^.

**Example 10: Specifying a mandatory field and reusable**

```
<dc:title>^Title[#T;*]|30+|^</dc:title>
```

**Comments**

Here the [\*] after the Title label is used to signify a mandatory field. Note: the mandatory command [\*] has not (yet) been implemented in the prototype.

## B.2.5 Repeating entries

In the case of a publication, there are often several authors. The “rdf” bag is used to manage this.

**Example 11: Repeating values**

```
<mvml:people bag="li" >
  <mvml:Person>
    <dc:creator>#F;, #I;, #P;</dc:creator>
    <vCard:FN>#F;, #G;, #P;</vCard:FN>
    <vCard:N rdf:parseType="Resource">
      <vCard:Family>^Family
Name[#F;]|30+|^</vCard:Family>
      <vCard:Given>^Given
Name(s) [#G;]|30+|^</vCard:Given>
      <mvml:Initials>^Initial(s) [#I;]|30+|E.g. M.H.^
</mvml:Initials>
      <vCard:Prefix>^Prefix[#P;]|
[:Ms::Mr::Mrs::Dr::A/Prof::Prof]|Eg. Ms, Mr, Mrs,
Dr^</vCard:Prefix>
    </vCard:N>
    <vCard:ADR rdf:parseType="Resource">
      <vCard:Country>^Country|30+|^</vCard:Country>
    </vCard:ADR>
    <vCard:ORG rdf:parseType="Resource">
      <vCard:OrgName>^Org. Name|30+|^</vCard:OrgName>
      <vCard:OrgUnit>^Org. Unit|30+|^</vCard:OrgUnit>
    </vCard:ORG>
    <vCard:ROLE bag="li">
      <mvml:RoleType>^Role|30+|Primary role in
organisation^</mvml:RoleType>
    </vCard:ROLE>
```

```

        <vCard:EMAIL rdf:parseType="Resource">
            <rdf:value>^Email address|30+|^</rdf:value>
            <rdf:type
rdf:resource="http://www.w3.org/2001/vcard-rdf/3.0#internet"/>
            </vCard:EMAIL>
        </mvml:Person>
    </mvml:people>

```

This will require the application to scan for the occurrence of a bag entry, and provide a 1 to many form/subform structure.

User input can be requested through the use of next and accept attributes, for example:

```

    <mvml:people bag="li" next="Enter another author(Y/N) ?"
    accept="Y">

```

In this case once the data for a person is added to the MVML file is completed the question “*Enter another author(Y/N) ?*” is asked and if “Y” is entered another person can be added.

### B.2.6 Derived values

If a value is derived from other inputs then do not surround the value with the ^. The replace will automatically copy the values entered to the # labels.

### B.2.7 Choice blocks

The ability to group a set of tags that can be skipped if the user wishes, is proposed as a future extension. The syntax is described in the following example.

#### *Example 12: Choice block*

```

    <mvml:ref choice="Do you want to enter reference information?">
    ... nested tags
    </mvml:ref>

```

The value of the choice statement is the question to be asked to the user.

## B.3 Example XTG Files

### B.3.1 Generic metadata information

The file shown in Figure B-3 (called *mvml\_vMeDefault.xml* in the prototype) contains the MVML tags used as the basis for all multimedia object (MMO) metadata.

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf      = "http://www.w3.org/1999/02/22-rdf-syntax-
ns#"
  xmlns:dc       = "http://purl.org/dc/elements/1.1/"
  xmlns:dcterms  = "http://purl.org/dc/terms/"
  xmlns:vCard    = "http://www.w3.org/2001/vcard-rdf/3.0#"
  xmlns:oex      = "http://odrl.net/1.0/ODRL-EX"
  xmlns:odd      = "http://odrl.net/1.0/ODRL-DD"
  xmlns:mvml     = "http://www.virtualmv.com/1.2" >

  <rdf:Description rdf:about = "^M;^" >
    <dc:title>^Title[#T;*]|50,2+|^</dc:title>
    <dc:date>^Date issued[#DCD;]|^D:yyyy;^, ^D:mmmdd;|^Date
issued^</dc:date>
    <mvml:today></mvml:today>
    <mvml:RawUrl></mvml:RawUrl>
    <mvml:people bag="li" >
      <mvml:Person>
        <dc:creator>#F;, #I;, #P;</dc:creator>
        <vCard:FN>#F;, #G;, #P;</vCard:FN>
        <vCard:N rdf:parseType="Resource">
          <vCard:Family>^Family
Name[#F;]|30+|^</vCard:Family>
          <vCard:Given>^Given
Name(s)[#G;]|30+|^</vCard:Given>
          <mvml:Initials>^Initial(s)[#I;]|30+|E.g. M.H.^
</mvml:Initials>
          <vCard:Prefix>^Prefix[#P;]|
[::Ms::Mr::Mrs::Dr::A/Prof::Prof]|Eg. Ms, Mr, Mrs,
Dr^</vCard:Prefix>
          </vCard:N>
          <vCard:ADR rdf:parseType="Resource">
            <vCard:Country>^Country|30+|^</vCard:Country>
          </vCard:ADR>
          <vCard:ORG rdf:parseType="Resource">
            <vCard:OrgName>^Org. Name|30+|^</vCard:OrgName>
            <vCard:OrgUnit>^Org. Unit|30+|^</vCard:OrgUnit>
          </vCard:ORG>
          <vCard:ROLE bag="li">
            <mvml:RoleType>^Role|30+|Primary role in
organisation^</mvml:RoleType>
          </vCard:ROLE>
          <vCard:EMAIL rdf:parseType="Resource">
            <rdf:value>^Email address|30+|^</rdf:value>
            <rdf:type
rdf:resource="http://www.w3.org/2001/vcard-rdf/3.0#internet"/>
```

```

        </vCard:EMAIL>
    </mvml:Person>
</mvml:people>

<dc:source rdf:parseType="Resource">
    <mvml:URI>
        <mvml:root>^sysHttp;^</mvml:root>
        <mvml:path>^Fdr;^</mvml:path>
    </mvml:URI>
</dc:source>
<dc:subject>^Subject|30+|Enter keywords separated with a
comma^</dc:subject>
<dc:rights>^Copyright|30+|Enter (C)opyright
Information^</dc:rights>
<oexrights>
    <oex:asset>
        <oex:context>
            <odd:uid idscheme="URI">
                ^sysHttp;^
            </odd:uid>
        </oex:context>
    </oex:asset>
    <oex:permission>
        <odd:display/>
        <odd:duplicate>
            <odd:constraint>MMO Copyright ^D:yyyy;^. All Rights
Reserved. Permission is granted for anyone to duplicate
this MMO, so long as the MMO (mvml file and manifest) is kept
intact </odd:constraint>
        </odd:duplicate>
        <odd:annotate/>
    </oex:permission>
</oexrights>
<mvml:context>^Context|40,2+|Describe the resource as if to
a blind person^</mvml:context>
    <mvml:ref>
        <endnotetype>^Endnote type|16{0{Journal
Article}::1{Book}::7{Book Section}::20{Manuscript}::9{Edited
Book}::8{Magazine Article}::5{Newspaper Article}::3{Conference
Proceedings}::2{Thesis}::10{Report}::4{Personal
Communication}::6{Computer Program}::16{Electronic
Source}::12{Audiovisual Material}::12{Film or
Broadcast}::13{Artwork}::11{Map}::15{Patent}::19{Hearing}::17{Bi
11}::22{Statute}::18{Case}::25{Figure}::26{Chart or
Table}::27{Equation}::31{Generic}}|^</endnotetype>
        <dcterms:abstract>^abstract|40,4+|^</dcterms:abstract>
        <dc:publisher>^publisher|^</dc:publisher>
        <dc:identifier>^identifier[#DCID;]||eg. ISBN,
ISSN^</dc:identifier>
        <mvml:biblioCitation>
            <mvml:secondTitle>^Secondary Title[#MBST;]||Enter
book/journal volume title eg. Journal of
XXX^</mvml:secondTitle>
            <mvml:volume>^Volume/Access
Year[#MBV;]|^D:yyyy;^|Enter book/journal VOLUME number or

```



## Appendix B

```
Access year (yyyy)
eg 2004^</mvml:volume>
    <mvml:number>^Number[#MBN;]^D:mmmdd;^|Enter
    book/journal number, or Access date(mmm dd), e.g. July
24^</mvml:number>
    <mvml:pages>^Page numbers[#MBP;]^|Enter book/journal
    page number eg. 123 or 123-134^</mvml:pages>
    <mvml:secondAuthor>^Editor(s)[#MBED;]^|Enter
    Editor(s) eg. (Eds.) K. Petrova, M.
Verhaart^</mvml:secondAuthor>
    <mvml:url>^Internet url[#MBU;]^|Enter url where found
    on internet^</mvml:url>
    </mvml:biblioCitation>
    <dcterms:bibliographicCitation>^Citation|[(#DCD;) #T;.
    Retrieved #MBV;, #MBN; from #MBU;::(#DCD;)
    #T;::(#DCD;) #T;(Eds.) #MBED;, #MBST;, #MBV;(#MBN;), pp #MBP;,
    ISBN/ISSN #DCID;::(#DCD;) #T;::(#DCD;) #T;, #MBST;,
    #MBV;(#MBN;), pp #MBP;, ISBN/ISSN
    #DCID;]^</dcterms:bibliographicCitation>
<comments>^comments|^</comments>
    </mvml:ref>
    </rdf:Description>
<mvml:manifest>
<mvml:mvmlMedia />
</mvml:manifest>
<mvml:annotations>
</mvml:annotations>
</rdf:RDF>
```

Figure B-3: Generic MVML template

In order to create a customized template for related objects, the generic file is modified, renamed as *mvml.xml*, and placed in the destination folder. When a new MMO is to be created, the object's files (using the ^ file naming convention) are copied into the folder, then the MVML file is created based on the customized template. If no customized template exists then the generic template is used.

### B.3.2 MVML Template: Media file models

An MMO can be made up of many different types of media files. The template file shown in Figure B-4 contains models used to generate the MVML metadata for individual media files. For example: if an MMO includes a *jpg* file the image model would be used (type = image); or for a

*YouTube* video the application type accepts the flash mime type (swf, flv), and requests the embed string.

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf      = "http://www.w3.org/1999/02/22-rdf-syntax-
ns#"
  xmlns:dc       = "http://purl.org/dc/elements/1.1/"
  xmlns:dcterms  = "http://purl.org/dc/terms/"
  xmlns:vCard    = "http://www.w3.org/2001/vcard-rdf/3.0#"
  xmlns:oex      = "http://odrl.net/1.0/ODRL-EX"
  xmlns:odd      = "http://odrl.net/1.0/ODRL-DD"
  xmlns:mvmml    = "http://is-
research.massey.ac.nz/verhaart/1.2" >

<revisionHistory>
  <rev date="2004-07-16">Created by M H Verhaart</rev>
  <rev date="2004-09-16">Author M H Verhaart, combine all types
into one file</rev>
  <rev date="2004-09-19">Test date</rev>
  <rev date="2004-09-20">Added | separator to ensure correct
match for file extensions. Added model wrapper tag to make
extraction of template easier. type tag after model for
clarity -- it is repeated in the template.</rev>
  <rev date="2005-06-17">
1. Changed ^[amp]x to ^x; as conflict problems with substitution
values in XML ([amp]amp;)
2. Changed selection separator from | to : to simplify coding
conflict between triple and alternative select
</rev>
  <rev date="2005-06-21">
1. Changed format from type and subtype to type/subtype in line
with MIME standard
2. Added qualified dc, i.e. dcterms:abstract,
dcterms:bibliographicCitation
3. endnoteTypes structured as XML and in MVMML template style
4. Revised triplet default (moved default and selection)
</rev>
  <rev date="2005-06-21">Changed file rights to public and
private</rev>
  <rev date="2005-07-23">Added mvmml:shortdsn to each to allow for
content of media element to be described</rev>
  <rev date="2005-09-28">Added other model type to cope with
undefined file types, note must be last one in model
list</rev>
  <rev date="2005-10-03">^[lt] must be at the end of a selection
tag as program looks for combo (avoids problems with ^
internally such as part of a filename. use tag must exist if
display to work properly</rev>
  <rev date="2005-10-13">Introduce formatted date tags
^D:mmmdd;^ and ^D:yyyy;^ to allow for default dates to be
generated</rev>
  <rev date="2005-11-10">Allow title to be replicated through
short descriptions of files, Requires changes to mvmml.xml in
individual folders.</rev>
  <rev date="2005-11-22">Add rss feeds as valid text
subtype.</rev>
  <rev date="2006-02-13">Add videoimage to image type (Note
video use= clip)</rev>
```

```

<rev date="2006-03-03">Add pptimage to image type</rev>
<rev date="2006-03-04">Add height and width to video for
Firefox compatibility (FF shows videos in thumbnail view if no
h x w specified!) and fix dc:citation choice</rev>
<rev date="2006-03-05">Changed drop box separator from : to ::
to allow for http://. Added new type of application called a
ref = allows all the reference data to be gathered without an
electronic artefact. Eg. In case you want to reference an
actual book or other physical object (eg. statue!!) also
added duration to video and audio
</rev>
<rev date="2006-03-08">Removed mvml:reference block and moved
to main block in mvml_lit.xml. This means all references need
to be stored in the same folder and given this xml file as the
template. This was done since the previous version created a
duplication problem if the MMO had multiple document
representations (e.g. doc and pdf) and required entering the
referencing information twice.</rev>
<rev date="2006-04-14">
1. Add background for (suggest 1024x768) wallpaper to image type
2. Add dsn to images for a photo of a plaque describing the
object
</rev>
<rev date="2006-05-23">Add director shockwave htm and dcr
types, Add ref type to text and applications. Where type = ref
and pdf or doc file can link to file and provide APA style
reference.</rev>
<rev date="2006-06-04"> UPDATE to mvml version to 1.2
*IMPORTANT change: With the development of XSLT stype sheets
there is now only one meta-template (mvml_vMeDefault.xml; - to
help identify context (location, content). mvml_creator,
_creators and _lit are now all depreciated into
mvml_vMeDefault.xml.
*In addition two new blank tags have been introduced; mvml:today
and mvml:RawUrl. These tags allow for dynamic substitution
into the XML file prior to transformation by the XSLT file.
For example, in ASP.NET the XML mvml XML file is read by the
application and prior to transformation todays date and the
current url of the object is inserted.
    strMVML = Replace(strMVML, "<mvml:today>", "<mvml:today>" &
System.DateTime.Now.ToString(" MMMM dd, yyyy")) and
    strMVML = Replace(strMVML, "<mvml:RawUrl>", "<mvml:RawUrl>"
& UriEncode(Request.RawUrl))
*The dc date now defaults to yyyy, mmm dd. In the case of a
reference this would usually be modified to the date issued,
and more often than not include just yyyy.
</rev>
<rev date="2007-09-22">Added Flash mime type in application for
YouTube flash movies</rev>
</revisionHistory>
<ErrorTypes>
<ErrType value="1">Check all tags match (use Internet explorer
or XML viewer</ErrType>
<ErrType value="2">Check three part tag, e.g. two |
characters</ErrType>
<ErrType value="3">MS-XML parser does not cope with duplicate
tag names (even with different namespaces) eg. dc:rights and
oem:rights</ErrType>
<ErrType value="4">If composite value (made up of other values
do not put hats round value</ErrType>

```

```

    <ErrType value="5">the hat character must occur immediately
    after the [lt] and before the [gt] in the tag value</ErrType>

</ErrorTypes>
<model>
  <type>text</type>
  <subtype>^[#ST;][plain{txt}::html{htm,html}::rich
  text{rtf}::rss{rss}]|^</subtype>
  <template>
    <rdf:File rdf:about = "^fn;" >
      <mvml:derived>
        <size>^ds;^</size>
      </mvml:derived>
      <mvml:annotated>
        <mvml:shortdsn>^short description|#T;|for
^fn;^^</mvml:shortdsn>
        <mvml:format>text/^#ST;^</mvml:format>

      <use>^choice|original[original::abstract::directorHTML::ref::r
ss]|Use type^</use>
      </mvml:annotated>
    </rdf:File>
  </template>
</model>
<model>
  <type>image</type>
  <subtype>^[#ST;][basic{gif,jpg,jpeg,png}]|^</subtype>
  <template>
    <rdf:File rdf:about = "^fn;" >
      <mvml:derived>
        <width>^dw;^</width><height>^dh;^</height>
        <size>^ds;^</size>
      </mvml:derived>
      <mvml:annotated>
        <mvml:shortdsn>^short description|#T;|for
^fn;^^</mvml:shortdsn>
        <mvml:format>image/^#ST;^</mvml:format>

      <use>^choice|original[alt::animated::background::con::dsn::gif
::icon:
::jpeg::original::png::pptimage::prn::sidebar::thumbnail::video
image]|Use type for ^fn;^^</use>
      <mvml:rights>^local
rights|private[private::public]|Enter private or Public for
^fn;^^</mvml:rights>
      </mvml:annotated>
    </rdf:File>
  </template>
</model>
<model>
  <type>audio</type>
  <subtype>^[#ST;][basic{wav,midi,mid}::mpeg{mp3}]|^</subtype>
  <template>
    <rdf:File rdf:about = "^fn;" >
      <mvml:derived>
        <duration>^Duration|00:00:00|hh:mm:ss for
^fn;^^</duration>
        <size>^ds;^</size>
      </mvml:derived>
      <mvml:annotated>

```

```

        <mvml:shortdsn>^short description|#T;|for
^fn;^^</mvml:shortdsn>
        <mvml:format>audio/^#ST;^</mvml:format>

<use>^choice|audio[audio::audioclip::audio_wav::audio_mp3::audio_wma::audio_midi]|Use type for ^fn;^^</use>
        <text>^Transcript or description|| for ^fn;^^</text>
        <mvml:rights>^local
rights|private[private::public]|Enter private or
Public^</mvml:rights>
        </mvml:annotated>
    </rdf:File>
</template>
</model>
<model>
    <type>video</type>

    <subtype>^[#ST;]| [mpeg{mpg,mpeg}::quicktime{mov}::microsoft{avi,wmv}]|^</subtype>
<template>
    <rdf:File rdf:about = "^fn;^" >
        <mvml:derived>
            <width>^Width|800|for
^fn;^^</width><height>^height|600|for ^fn;^^</height>
            <duration>^Duration|00:00:00|hh:mm:ss for
^fn;^^</duration>
            <size>^ds;^</size>
        </mvml:derived>
        <mvml:annotated>
            <mvml:shortdsn>^short description|#T;|for
^fn;^^</mvml:shortdsn>
            <mvml:format>video/^#ST;^</mvml:format>

<use>^choice|video[videoclip::video::video_avi::video_mov::video_wmv::video_mpg]|videoclip=inpage, video=new window: Use
type for ^fn;^^</use>
        <text>^Transcript or description||for ^fn;^^</text>
        <mvml:rights>^local
rights|private[private::public]|Enter private or Public for
^fn;^^</mvml:rights>
        </mvml:annotated>
    </rdf:File>
</template>
</model>
<model>
    <type>application</type>

    <subtype>^[#ST;]| [msword{doc}::adobe{pdf,dcr}::zip{zip}::ref{ref}::x-shockwave-flash{swf,flv}]|^</subtype>
<template>
    <rdf:File rdf:about = "^fn;^" >
        <mvml:derived>
            <size>^ds;^</size>
            <embed>^Embed code for flash|30+|Make sure you
substitute less than and greater than symbols with lt and
gt^</embed>
            <url>^Url code for flash movies|30+|^</url>
        </mvml:derived>
        <mvml:annotated>
            <mvml:shortdsn>^short description|30+#T;|for
^fn;^^</mvml:shortdsn>

```

```

        <mvml:format>application/^#ST;^</mvml:format>

        <use>^choice|original[abstract::directorSW::doc::original::pdf
        : :ref::youtube::zip]|Use type^</use>
        <mvml:rights>^local
        rights|private[private::public]|Enter private or Public for
        ^fn;^^</mvml:rights>
        </mvml:annotated>
        </rdf:File>
        </template>
    </model>
    <model>
        <type>other</type>
        <subtype>^[#ST;][other{}]|^</subtype>
        <template>
            <rdf:File rdf:about = "^fn;^" >
                <mvml:derived>
                    <size>^ds;^</size>
                </mvml:derived>
                <mvml:annotated>
                    <mvml:shortdsn>^short description|#T;|for
                    ^fn;^^</mvml:shortdsn>
                    <mvml:format>other/^#ST;^</mvml:format>
                    <use>^choice|original[original::ppt::other::visio]|Use
                    type for ^fn;^^</use>
                    <text>^Transcript or description|#T;|^</text>
                    <mvml:rights>^local
                    rights|private[private::public]|Enter private or Public for
                    ^fn;^^</mvml:rights>
                    </mvml:annotated>
                </rdf:File>
            </template>
        </model>
    </rdf:RDF>

```

Figure B-4: MVML media template (mvmlMedia.xml)

## B.4 Miscellaneous Notes

In some cases it would be useful for a file, such as an html file, to be able to use an object within the MMO. For example, when creating an html based curriculum vitae, an image could be included from within the MMO. To maintain the integrity of the MMO it is important that the MMO is self contained and does not require external files to complete an internal object.

## B.5 Conclusion

This appendix presents the current structure and syntax of an XML Template Generator (XTG). While its purpose was to help generate efficiently the MVML file for the MMO, its use can be generalized to building any XML file where there is common metadata. The ability for a

## Appendix B

computer to read the XTG and create a user input form, gives it flexibility, customizability and extensibility.

The XTG is continually under review with enhancements made as and when required, for example, the addition of a YouTube media object was added in the middle of 2007.

## C      **The virtualMe Framework guided tour**

Before the virtualMe prototype could be evaluated, some basic training was required for the users. To assist, online tutorials were provided in three modes: as a PowerPoint overview, as a walk through that could be printed, and as a video tutorial.

This appendix contains the printed guided tour. The PowerPoint and video are available at <http://www.virtualmv.com>.

---

### **The virtualMe Framework – guided tour**

---

**Version 1.06**

Welcome to this short guided tour to show off the features of the virtualMe prototype.

#### **C.1      Brief introduction**

As a face-to-face (f2f) lecturer in information technology, I am interested in using technology to assist in the delivery of learning materials, and assist in student learning. Students have information and knowledge that is shared in a f2f environment, and in this way knowledge is constructed. My interest is in trying to find answer to the question: “can this knowledge be captured in context using internet technologies?” From experience, teaching and learning is person centred for both instructor and student, with the instructor providing resources and knowledge to guide the learner. Based on this paradigm, a prototype knowledge acquisition, management, sharing and dissemination framework has been developed that is centred on an individual, and has been coined the *virtualMe*.

#### **C.2      Joining the system**

When you arrive at the first page you will notice that the different people are shown on it (Figure C-1), and as mentioned earlier, this is because the virtualMe is centred on a person. For now, Michael Verhaart is the person we will use.



## Appendix C

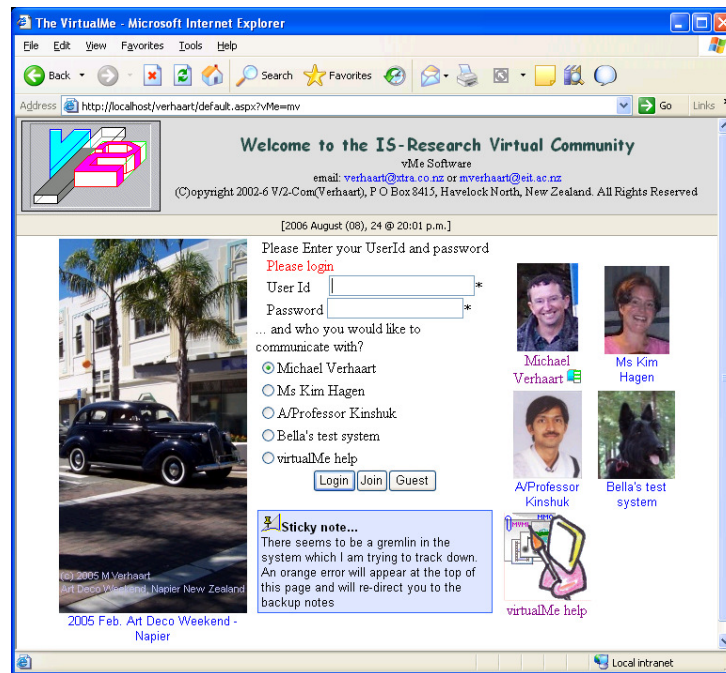


Figure C-1: vMe Community

The first thing you need to do is to [Join] the community that accesses the virtualMe. So, select Michael as the person you would like to communicate with and click [Join]. The screen shown in Figure C-2 will then be displayed.

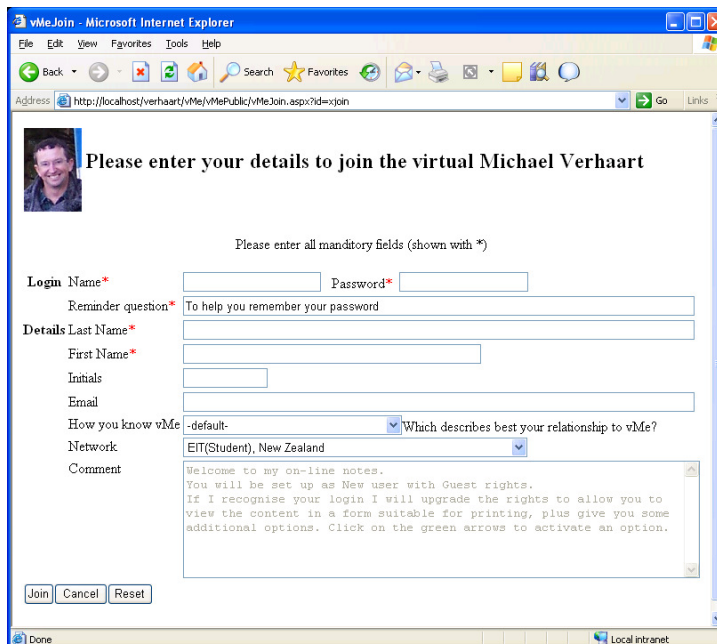


Figure C-2: Joining a vMe Community

Fill out the details and click [Join] and you are ready to become part of the community.

So, now that you have joined, you need to log in to the virtualMV. Enter your userid/password to login to the system.

If all is ok a page similar to Figure C-3 will be displayed (if you are having trouble joining, use the [Guest] option).

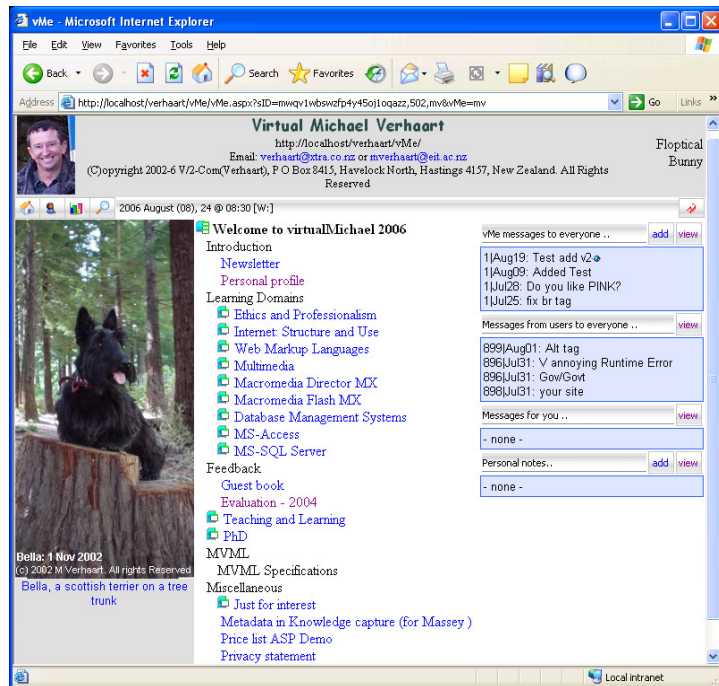


Figure C-3: vMe main page

A picture of the person who is the virtualMe is shown at the top left of the start page. The body of the page shows a personal image on the left (which changes), a list of topic areas in the center and comments on the right of the screen (messages and annotations).

## C.3 The Multimedia Object (MMO)

When working with media on the internet it is useful to be able to view the element in different ways.

For example a person can have:

- a photo, a file containing curriculum vita (CV), a business card.

An image can have:

- different sizes, a description, copyright information.

When we copy a media element on the web we will lose much of this contextual information.

So, one outcome of this research is that each media element is part of a collection. In the virtualMe, this is called an MMO (Multimedia object), and is a collection of things that belong together. A special file is used to hold the data that describes the collection. This is known as the MVML file as it is written in XML and contains meta-data about the collection.

## Appendix C

So to demonstrate, click on my photo and this will link to the MMO display page (Figure C-4).

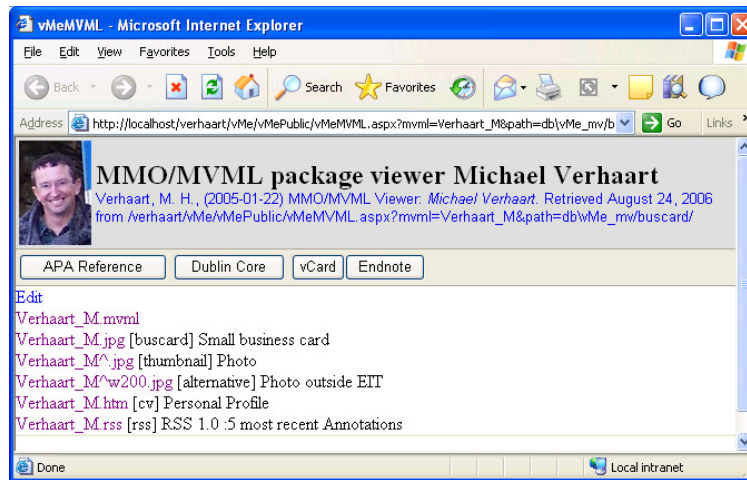


Figure C-4: MMO/MVML display page

You will see a list of the files that make up the MMO.

Click on the file list to view different representations (photo business card, CV)

Click on the buttons to view details in different popular meta-data formats (APA Reference, Dublin Core, vCard and Endnote).

The mvml file (written in XML using a Multimedia Vocabulary Markup Language) contains Meta-data for the MMO and includes data and information about the author, copyright and a description of the object, a list of the related files, plus meta-data that allows other formats to be created.

The ability to click on a media object and drill into multiple representations and get information about the object is available for all objects in the virtualMe.

Now close the window to show the main screen (Figure C-3).

### C.4 The annotation framework

An important part of the virtualMe is the annotation framework. Here messages can be left both out of context, such as when a message to all users is needed, or in context when the note is attached to some existing content. You can also select who is able to read your message (everyone, just vMe, or just you). vMe can also send messages just to you.

The five most recent messages in each section are displayed on the main screen (Figure C-3). If you hover your mouse over the title the message will be displayed as a tooltip. Also, if there is a URL in the body of the annotation a small animated globe is displayed, and clicking on this will take you to the URL specified. Click on the [View] button to display a list of all the annotations, then on the Annotation page click on the title of the annotation you wish to read (Figure C-5).

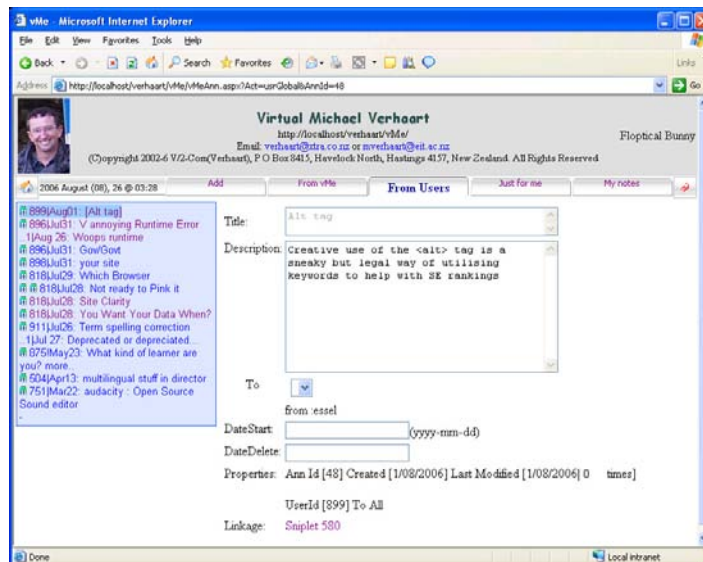


Figure C-5: Annotation viewer

Clicking on the “add a thread” icon (🧩) will allow you to attach a comment to the annotation.

Use the [home] button (icon of a house at top left) to return to the vMe home page (the image on the page is a personal photo and is randomly generated – it is there to try and create a sense that you communicating with the virtualMe).

## C.5 Viewing some content (a snippet)

In a face-2-face lesson we use an Overhead Slide (commonly referred to as an Overhead transparency or OHT) to present content. This has proven to be a good size to be able to manage and annotate. So the system is composed of lots of OHTs structured in a course.

An OHT is made up of text, media, annotations and references, so needed a name. The term SNIPILET was created, meaning a piece of content that can be displayed on one OHT, and some of you will recognize this as a Learning Object.

If we look at the Multimedia topic, you will see it arranged in sub-topics. Each sub topic is then constructed out of snippets.

- Click on the “**Multimedia**” topic, then **Animation**

We can view each of these in order (What is animation? ...) or in a random order.

- Select “**Example of a gif animation**”
- As students would normally view this, a notes view is displayed.

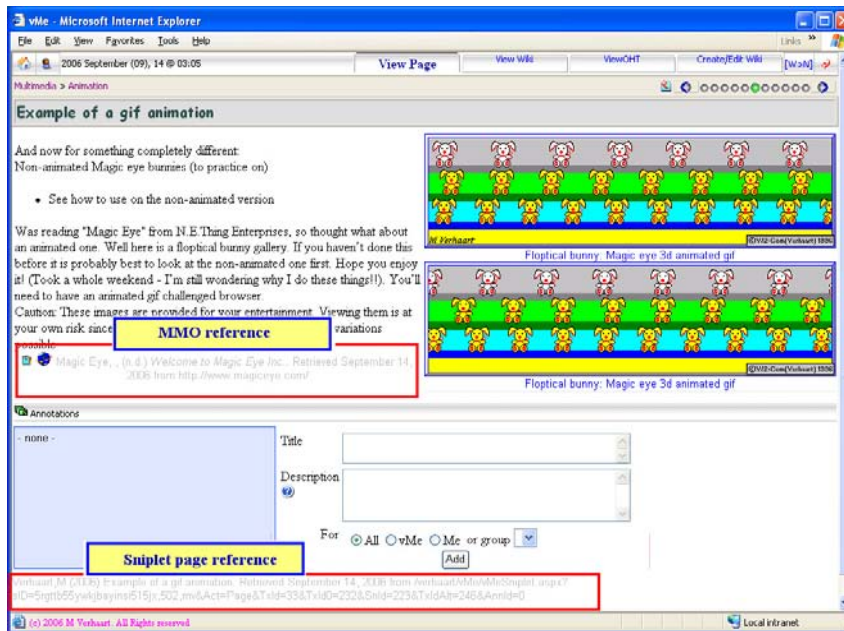


Figure C-6: Snippet in page view mode

This displays the content represented as a snippet. Simply put, a snippet is a piece of content that can be displayed on one overhead projection. Figure C-6 shows a snippet in page view, which is the one a student would use to read the content.

If you are teaching from it, it would be good to display it in an OHT view.

In a formal face to face lecture it would be better to display just the main points and enlarge the fonts. This is achieved using the Overhead Transparency view.

- Click the **ViewOHT** tab, and the view will change (Figure C-7).

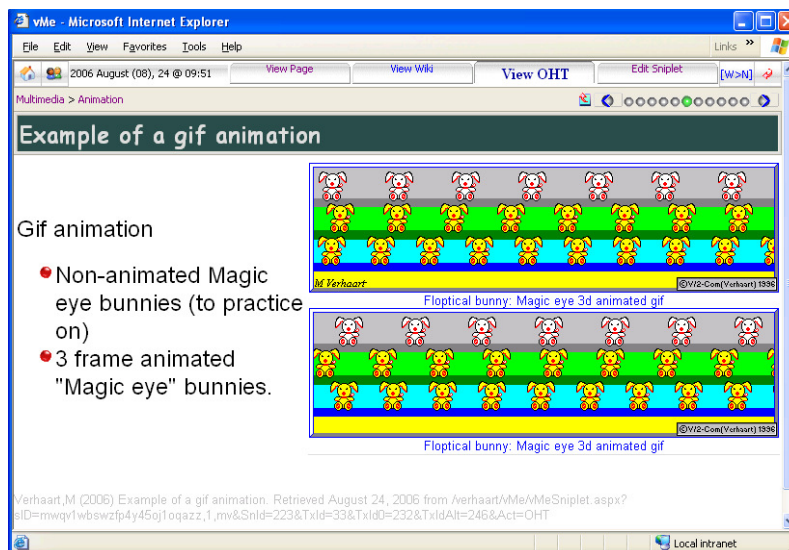



Figure C-7: Snippet in OHT view mode



Notice how the fonts are enlarged and the content is now displayed as a series of bullet points.

(While you are here you may like to try and see the 3D effect)

Some things to observe:

- At the bottom of the screen is an APA style reference for the page; It is an MMO so you can click on the MMO icon to get the package or the world icon to get the URL. Additionally it is displayed in an APA style reference. All this is out of the MMO.
- There are two images: a static image and an animation. They are both closely related so logically form part of the same MMO. Click on either image to display the MMO viewer;
- Above the annotation section is a reference MMO leading to a web site.
- At the top right of the screen is a series of balls that show where this snippet is in relation to the others in this sequence. In OHT view you can use Microsoft's PowerPoint navigation to go from snippet to snippet (up and down arrows), so you can use a remote compatible with PowerPoint to move from snippet to snippet. There is an [upLevel] button (  ) to the left of the navigation balls.
- Annotations can be added in Page view mode, and if exist, will be displayed in both Page and OHT view.
- The **Create/Edit Wiki** tab would allow you to take a copy of the existing snippet and modify it to be your own. The **View Wiki** tab would allow you to display it. This is not currently implemented.

## C.6 Annotating snippets

Notice the annotation area at the bottom of the page (snippet). This allows you to comment on the snippet being displayed. This is an important part of the prototype as this keeps your annotations in context (that is, it is attached to the piece of content it belongs to). Feel free to add an annotation just remember the system is live, and students are using it for their study!

It is possible to target the annotation, so you can send one just to the virtualMe, to all users or add a personal comment.

## C.7 Viewing snippets in continuous view

If you have joined the system, an option to show the snippets in a continuous view is available. The snippetListAll icon at the top of the menu list allows you to create a page with all the snippets on the page being displayed (Figure C-8).

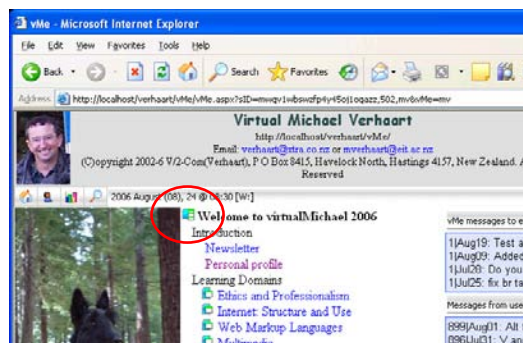


Figure C-8: Snippet “List all” feature

## Appendix C

This allows users who wish to take a printed version of the notes to have the snippets joined up in a continuous page rather than having to access each page individually (and it saves lots of paper!).

### C.8 The same snippet in many places

Another important thing is the ability for a snippet to be included in many places.

Try it out:

1. Navigate to
  - **Multimedia > Graphics > Graphics Interchange Format (GIF)**

While you are here ...

- Click on the [ViewOHT] Tab, to see the snippet as it would be displayed in a teaching session.

Return to the start menu (click on the home button)

2. Navigate to
  - **Web Markup Languages > HTML and XHTML > Graphics Interchange Format (GIF)**

### C.9 The MMO at work

One issue that many researchers struggle with is managing the large number of references that they accumulate. The MMO is a powerful way to manage references. If you have a URL, an electronic copy, or a reference to a physical entity (like a book), you can create an MMO for it. As it allows for multiple representations, a file (such as a pdf) can be attached. Once created as an MMO, software can be written to search your computer for the MMO file and retrieve the reference.

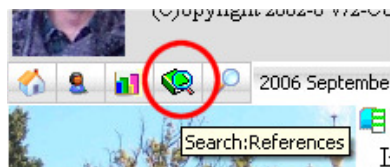


Figure C-9: Search Reference button

To show how this can be achieved, return to the home page and then

- click on the [Search:Reference] button on the main menu page (Figure C-9).

The system will then search through all the folders, reading the MMO files and will construct an APA reference using the MVML file.

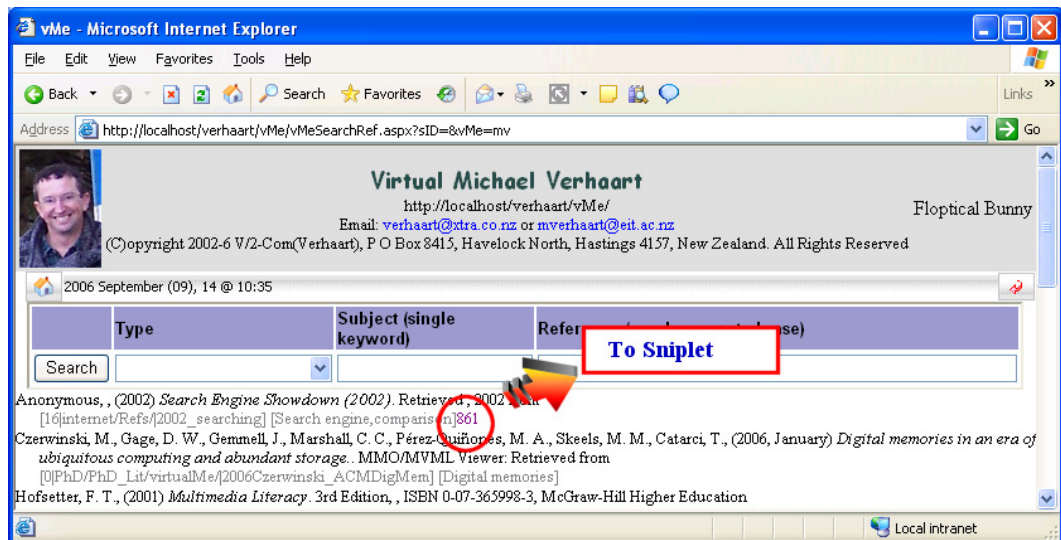


Figure C-10: MMO Search Results

The quality of the search can be improved by applying filters. In the prototype, the following filters were available: reference type (such as, journal article, electronic source), keyword, or matching an exact word or phrase.

This could be extended to searching for other attributes that are contained in the MVML file, such as authors and abstracts.

You may also notice a hyperlinked number at the end of each APA reference. Clicking on this will link to the snippet that uses this reference (Figure C-10).

Another use of the MMO is managing contacts. You have already clicked on my photo and seen the multiple representations. If you do this for all of your contacts, you can create a searchable business card list. But, as the MMO can package different representations, the contact list can include photos, CV's, maybe even a short video clip.

The MMO also provides us with multiple entry points to display a concept. The following snippet shows how an MMO can include a training video and display the result in the same snippet.

Navigate to

- **virtualMe examples > WAV: Windows Sound Recorder**

The snippet allows three ways to access the MMO (and parts):

The top image shows the result of the sound recorder user interface;

Clicking on the video screen links to the MMO; and

Clicking on the run button will load a new window and run the video (you may need to activate the video control by clicking on it before it will run).



## C.10 System Customisation

While it is possible to create a complete personalized interface with different icons and buttons, to demonstrate how you can individualise your view, click on the MyProfile button (icon of a person to the right of the home button). This will bring up your profile page (Figure C-11).

The screenshot shows a web browser window titled 'vMe - Microsoft Internet Explorer'. The page is 'Virtual Michael Verhaart' with a URL of 'http://localhost/verhaart/vMe/'. It includes contact information for Michael Verhaart and a copyright notice. The main content is a 'My Profile' form for a user named 'Floptical Bunny'. The form has sections for 'Login' (Name, Password, Level), 'Details' (Remainder, Last Name, First Name, Country, Age, Culture, Language, Email), 'Referencing Style' (APA referencing), 'Rights' (Name, Edit by vMe only), 'View (CSS)' (vMe, Page, OHT), 'Display' (Icon/text, Icon, Frames, NoFrame, Page/OHT, Page), 'Media' (Local, Web, Network), and a 'Comment' field. At the bottom are 'Cancel', 'Reset', and 'Update' buttons.

Figure C-11: My Profile page

- Selecting an item from the View CSS (vMe) drop down box will allow you to change the colour scheme of the site. It is also possible to have a local style sheet for the site (though this exploits the ability of Internet Explorer to include content from a local hard disk onto a web page so may not work in other browsers).

Change the style sheet and see how this affects your system.

## C.11 Some other features

- A basic search function is available – use the magnifying glass icon
- Statistics of site usage are available using the bar-graph icon
- On the first page is a menu item “virtualMe examples”. This collection of snippets shows different types of MMO/MVMLs attached to snippets.

So, feel free to explore the system. Please leave messages for me, students or others who use the site, as the purpose is to create an environment that mimics the one found in a face-to-face classroom. If you have some time, I would really appreciate some feedback. There is a survey at the bottom of the virtualMV home page (<http://www.virtualMV.com>).

**Thank you for trying out this system, as this allows me to test some of my ideas in a real and tangible way.**

**– End of guided tour ...**

## D The virtualMe survey and ethical approvals

In order to gather data to support the Technology Acceptance Model (TAM) relating to the perceived ease of use and usefulness of the virtualMe framework, a survey tool was developed. The following survey was provided in an online environment and may be viewed at <http://www.virtualMV.com/vMeevaluation/evDefault.aspx>. Figure D-1 illustrates the survey entry screen.

evDefault - Windows Internet Explorer provided by Eastern Institute Of Technology

http://www.virtualmv.com/vMeevaluation/evDefault.aspx

File Edit View Favorites Tools Help Contribute Edit in Contribute Post to Blog

evDefault

### Welcome to the virtualMe on-line Research survey

Welcome and thank you for your help in this very important part of my research. Gathering user feedback allows the effectiveness of what is being researched to be determined. This online survey allows you to enter your responses efficiently and anonymously while providing a mechanism to distribute the survey results.

**Before you complete the survey**, you need to have had some experience with the virtualMe prototype (<http://www.virtualMV.com>). If you have not experienced it before, there is a walkthrough document which covers the main things that the survey covers. The walkthrough is a word document file (or pdf), in the sticky note window on the virtualMV home page.

#### How it works and Instructions

1. A survey is set up by a researcher and is selected from the drop down list box called Research Id.
2. To prevent the survey from appearing in search engines, you will need to enter the survey code.  
Enter 55 (fifty-five) into the Survey Code box.
3. So that you can change any of your responses at a later date (while the research is active), create your own personal unique identifier (so this is completely anonymous). Remember that others are making up their own as well, so make it one others are unlikely to choose.
  - o If this is your first time, create a code with a maximum of 15 digits/characters that you can remember
  - o If you want to modify earlier responses enter the code, and earlier responses will be displayed.
4. A [Save] button is at the top and bottom of the survey, and you should save if you need to leave the survey for a little while. This ensures that if the internet connection is lost your responses will have been saved.

#### As a participant in the research you can

- Withdraw at any time - use the [Exit] button
- Decline to answer - leave the drop and/or comment boxes empty
- Ask further questions. Place them in the comment box and these should be answered in the same comment box by the researcher (or email [mverhaart@cit.ac.nz](mailto:mverhaart@cit.ac.nz)).
- Ask others for support/assistance
- Access the research findings. These will be automatically generated once the research is concluded, and accessed via your unique identifier

**Please enter...**

Research Id: virtualMV Survey [ Open ]

Survey Code:

Your unique identifier:  (maximum 15 characters)

Login Quit

#### Before filling in the survey

Access the virtualMV system at ... <http://www.virtualMV.com>

- If you have not used the system before there is a guided tour. The links are shown in the notes area of the virtualMV
- For a printed version of the survey that includes Ethical approval information and a background to the research you can download  
vMeResearchSurveyv5\_rc2a : [doc] 242K, or [pdf] 102K  
and if you wish, email to : [mverhaart@cit.ac.nz](mailto:mverhaart@cit.ac.nz) or post to : M Verhaart, EIT Hawkes Bay, Private Bag 1201, Taradale, NAPIER 4141, New Zealand.

Figure D-1: Entry screen to virtualMe survey

Participants were asked for the following data:

- A research identifier that allowed the software to manage multiple surveys.
- A survey code that prevented misuse of the survey, such as “spamming”
- A unique user identifier created by the participants. This was fully under the control of the participant to ensure they remained anonymous to the researcher.



HAWKE'S BAY

*Te Whare Takiura o Kahungunu*



Te Kunenga ki Pūrehuroa

## The virtualMe survey (with comments)

**Researcher:** Michael Verhaart, EIT Hawke's Bay, TARADALE, New Zealand,  
[mverhaart@eit.ac.nz](mailto:mverhaart@eit.ac.nz)

### D.1 Introduction

Welcome to this survey that has been designed to research aspects of multi-media storage on the internet, and an associated environment built to demonstrate how this could be done. So that you can provide interesting and informed feedback it is necessary to experience the virtualMe system. Your contribution will help me to improve and enhance the ideas being explored and provide useful commentary for other researchers in this field. Hopefully, you also will learn how to access and use this resource which may be of use to you in your work or studies.

This survey is based on the virtualMe system that can be found at <http://www.virtualMV.com>. There is a link to the electronic version of the survey and a guided tour on the home page (in the sticky note). A backup site is available at <http://is-research.massey.ac.nz/verhaart/default.aspx>.

### D.2 As a participant in the research you can:

- Withdraw at any time ;
- Decline to answer any question;
- Ask others for support/assistance;
- Access the research findings. It is hoped these will be automatically generated once the research is concluded, and accessed via the *survey code* and your *unique identifier* at <http://www.virtualMV.com/> ; and,
- Ask further questions, to request a copy or to receive notification, please email [mverhaart@eit.ac.nz](mailto:mverhaart@eit.ac.nz) .

---

**Massey University:** *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*

*If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethics & Equity), telephone 06 350 5249, email [humanethicspn@massey.ac.nz](mailto:humanethicspn@massey.ac.nz) , or*

**Eastern Institute of Technology:** *"This project has been evaluated by the Research and Ethics Committee with supporting documentation that was presented to Massey University". If you have concerns and are associated with EIT please contact Dr. A. Sundar, Chair, EIT Research Committee, EIT. Telephone. 974 8000 ext 5011, email: [asunder@eit.ac.nz](mailto:asunder@eit.ac.nz)*

## D.3 Background

As a face-to-face lecturer in Information and Communications Technology, one of my interests is to combine face-to-face teaching with modern technology, usually referred to as *blended teaching*. Of particular interest was the ability to capture the knowledge that the students have and include this in teaching content, while creating an environment that would support face-to-face delivery plus provide the benefits that web-based technology offers.

This has lead to two areas of research: The first into capturing of knowledge; and the second in developing a framework that could be used to support the teaching and learning of both myself and my students.

In order to test the frameworks and models developed an online teaching and learning support environment has been developed. This has evolved over several prototypes with the current version based on research done over the past few years. As a lecturer in multimedia, web and databases it also has been a way to keep up-to-date with current technologies in these areas.

The system has been in use as a support tool for content delivery at the Eastern Institute of Technology. You are invited to explore the system and try the functionality before filling in the survey, so that you will be able to offer informed and interesting feedback. While doing this, it is my hope that you also will have a chance to evaluate whether the system can be useful for your future work or study.

VirtualMe is a live system and if you are adding comments remember that users are interacting with it for their studies. It would be really neat if you could add some of your own knowledge if there is something you would like to contribute. The system can be accessed via the web URL (or a link) on; <http://www.virtualMV.com>

## D.4 Some definitions

<b>Multimedia object (MMO)</b>	The MMO is a collection of related files treated as a unit. It may be made up of several files, and includes an XML file that contains information about the object such as creator, title, description, etc. (Verhaart, Jamieson & Kinshuk, 2004).
<b>Snippet</b>	A piece of knowledge or information that could be represented by one overhead transparency (Verhaart, 2003).
<b>virtualMe</b>	A framework that is used as the basis of an interactive teaching and learning delivery system used in a blended teaching and learning environment. (Verhaart, & Kinshuk, 2005).

## D.5 References

- Verhaart, M. (2003). [Developing a capture of knowledge system based on sharable and self documenting learning objects](#). *Educational Technology & Society*, 6 (3), 1-16. ISSN 1436-4522 Retrieved August 5, 2003 from: [http://ifets.ieee.org/periodical/6\\_3/1.html](http://ifets.ieee.org/periodical/6_3/1.html)
- Verhaart M., Jamieson J., & Kinshuk (2004). Collecting, organizing and managing non-contextualised data, by using MVML to develop a Human-Computer Interface. In M. Masoodian, S. Jones, & B. Rogers (Eds.) *Lecture Notes in Computer Science*, 3101, 511-520. Springer-Verlag
- Verhaart M., & Kinshuk (2005). Developing a user centered model for creating a virtual learning portfolio. In Ghaoui, C.; Jain, M.; Bannore, V.; Jain, L.C. (Eds.), *Studies in Fuzziness and Soft Computing*, Vol 178, pp. 203-232.. Springer-Verlag.

## D.6 Something about you

Your unique identifier

(A combination of 6-12 letters and numbers that you think will be unique to you). This will allow you to access the results of the survey on-line.

This section will help me to understand your point of view.

Please select **one** of the options unless multiples are indicated.

<p>Please indicate if you are a student in one of Michael's classes or are working closely with him (As an example, someone working closely would be in Info Technology at EIT or a Massey Supervisor).</p> <p><i>Comment:</i> This question ensures that there is no direct relationship which could influence how the survey is to be filled out. For example, a Lecturer/student power relationship, or colleague/colleague</p>	<p><input type="radio"/> A student of Michael</p> <p><input type="radio"/> Closely work with Michael</p> <p><input type="radio"/> Other</p>
<p>Please indicate how you have interacted with virtualMe.</p> <p>If <i>other</i> please specify :</p> <p><b>Note:</b> In order to complete this survey it is necessary that you have at least examined the online virtualMe system. Click on the following link to access the site if you have not... <a href="http://www.virtualMV.com">http://www.virtualMV.com</a></p> <hr/> <p><i>Comment:</i> This question identifies the extent to which a user has been exposed to the system. A person who has "used" the system will have a deeper understanding and therefore should be able to provide more detailed and informed feedback.</p>	<p><input type="radio"/> Examined</p> <p><input type="radio"/> Tested</p> <p><input type="radio"/> Used</p> <p><input type="radio"/> Seen a demonstration</p> <p><input type="radio"/> Other</p>
<p>Please indicate to which group you belong</p> <p>(Please check all that apply.)</p> <p>If <i>other</i> please specify :</p> <p><i>Comment:</i> This identifies the type of user and therefore their interest bias. For example an educator would look to the system from a presentation view and how content is disseminated, a student from a content delivery view and a visitor from an interest view.</p>	<p><input type="checkbox"/> Student,</p> <p><input type="checkbox"/> Educator</p> <p><input type="checkbox"/> Visitor</p> <p><input type="checkbox"/> Other</p>
<p>Please indicate your level of computing confidence</p> <ol style="list-style-type: none"> <li>1. A novice would rarely use a computer, maybe to clear emails or use a word processor or equivalent</li> <li>2. An ok user is happy working on a computer but seeks help when</li> </ol>	<p><input type="radio"/> 1 Novice</p> <p><input type="radio"/> 2 Ok</p> <p><input type="radio"/> 3 Confident</p> <p><input type="radio"/> 4 Proficient</p> <p><input type="radio"/> 5 Expert</p>

<p>needed</p> <ol style="list-style-type: none"> <li>3. A confident user would be able to use a computer managing files, downloading from the internet and using a variety of applications</li> <li>4. A proficient user would be able to happy to provide assistance to others</li> <li>5. An expert would create software, and would be considered a power user.</li> </ol> <p><i>Comment: This will identify the user level and identify whether comments made are with prior knowledge or based on the experience with the system.</i></p>	
<p>What is the highest qualification that you have or are studying for? If you are not sure what to choose, use <i>other</i> and please describe.</p> <p>_____</p> <p><i>Comment: As this project is set in an education context, it is important to identify what level of education the participant has.</i></p>	<p><input type="radio"/> Non Tertiary  <input type="radio"/> Degree  <input type="radio"/> Postgraduate  <input type="radio"/> Other</p>
<p>Identify the main domain you study/work in (For a student what area you are studying, for a lecturer your main teaching area)? For example, Information Technology (IT), Science, Arts, Health, Trades, ...</p> <p>_____</p> <p><i>Comment: This will identify if there is any domain bias, and to determine how wide a range of domains the survey covered.</i></p>	
<p>What age range are you in?</p> <p><i>Comment: There is much discussion regarding the technological capabilities of younger students who have grown up with technology. This question considers what age band the respondent is in and may be used to see if there is any age bias in the survey.</i></p>	<p><input type="radio"/> &lt; 20  <input type="radio"/> 20-29  <input type="radio"/> 30-39  <input type="radio"/> 40-49  <input type="radio"/> 50-59  <input type="radio"/> 60 &gt;</p>
<p>Are you male or female?</p> <p><i>Comment: It is often quoted that females are more capable of multi-tasking and prefer socio-constructivist modes of learning. This question allows this bias to be explored.</i></p>	<p><input type="radio"/> Male  <input type="radio"/> Female</p>
<p>Please indicate which country you are a citizen of. of ( if more than one choose which you identify most with, and add a comment if you wish. )</p> <p>_____</p> <p><i>Comment: This question is asked to ensure that there is not a local bias and to ascertain whether there is a variation between local and international feedback. It is intended that the survey participants will be both local (New Zealand) and international. This question will allow the geographical spread of respondents' to be determined.</i></p>	

## Appendix D

<p>What type(s) of personal web presence do you have?</p> <p>(Please check all that apply.)</p> <p>If <i>other</i> please specify :</p> <hr/>	<ul style="list-style-type: none"><li><input type="checkbox"/> None</li><li><input type="checkbox"/> Wiki</li><li><input type="checkbox"/> Blog</li><li><input type="checkbox"/> MSN spaces</li><li><input type="checkbox"/> MySpace</li><li><input type="checkbox"/> BeBo</li><li><input type="checkbox"/> Personal Web</li><li><input type="checkbox"/> Other</li></ul>
<p><i>Comment: This is to determine whether the person has had hands-on exposure to a personal web presence.</i></p>	

## D.7 Questions for perceived usefulness

### Overall framework

<p><b>Research question:</b></p> <p><i>“What features are desirable in a generalized framework that allow for the acquisition, management and sharing of an individual’s information and knowledge in an educational environment?”.</i></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"><li>• <i>To determine features of virtualMe that are considered important by direct (vMe and students using the system as part of the course) and indirect (visitors) users.</i></li><li>• <i>To ascertain if the virtualMe gives a feeling that you are interacting with a person as opposed to online content.</i></li></ul>
--

The virtualMe presents a framework in which many features are demonstrated. For each of the following statements please rate in order of usefulness.

**Notes:**

A *Sniplet* is a piece of content that can be displayed on one overhead projection.

	(Please circle)				
	Useless	Not useful	Useful	Very useful	Don't know
The ability to view content in a page layout is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ability to view content in a display (overhead) layout is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ability to combine content into a continuous view suitable for printing is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ability to include content in many places (for example, a snippet describing the gif file format can appear in notes for web and multimedia) is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ability to customise your interface (Select icons, text or both, change the look, e.g., colours) is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To have referencing information available on each page is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The “feeling” that I am interacting with a person rather than content is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The “feeling” that I am part of a network of users is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
One goal of virtualMe is to give the impression that you are conversing with an individual. To this end, the user interface can be changed, personalised images can be included, and messages from the lecturer can be sent. I find these personalisation features of virtualMe were useful to place the content in a context (i.e. gave the content meaning) is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please list and/or describe any other features you found useful (or you think would be).

Please list and/or describe any other features you did **not** find to be useful.

Please add any other comments, if you wish:



## Annotation framework

### *Research question:*

*“Can a framework be developed that allows other people to add information and knowledge that will benefit all users of the system?”*

### *Objectives:*

- *To determine the importance of annotations from different user groups.*
- *To determine whether multimedia annotations are useful.*
- *To determine whether annotations add value.*
- *To determine the effectiveness of having information and knowledge change via annotations.*

**Comment:** *Annotations are used in the virtualMe to allow users to add comments in context. The following questions look at which comments users consider are important in relation to context.*

There are several features in the system allowing content to be entered in context. For each of the following statements please rate how useful it is.

	(Please circle)				
	Useless	Not useful	Useful	Very useful	Don't know
The ability to target an annotation to a specific user is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Messages to/from the virtualMe are ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Messages to/from everyone are ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Messages to/from a specific individual (other than the virtualMe) are ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Messages to yourself (reminders, side notes) are ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ability to annotate each snippet is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To be able to copy of a piece of content and make private changes (Wiki) is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Adding a comment to a specific media element such as an image is /would be ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Annotations that are text based are ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Annotations that are multimedia (images, audio, video) are ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ability have content changed over time due to adding annotations is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Annotations generally are ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please add any other comments, if you wish:

## Resource acquisition, management and sharing at source

### *Research Question:*

*“Can a model be developed that has the ability to retain context while transferring the content from one person to another and from one place to another?”*

*Comment: The following questions look at whether the Multimedia object is perceived as a useful model to distribute content while maintaining context.*

### *Objectives:*

- To determine if the MMO is useful for displaying media.*
- To determine if the MMO is a useful model for transferring media objects.*

	(Please circle)				
	Useless	Not useful	Useful	Very useful	Don't know
To have meta-data, referencing and digital rights information available for each media element is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ability to drill down on each media element to see additional information is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To be able to display a media element in a variety of ways is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would find the ability to copy a media object that contains contextual information such as author, ownership and a description ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please add any other comments, if you wish:

## Teaching & Learning

### *Research Question:*

*“Does the virtualMe framework provide additional benefits that are not available in current teaching and learning environments?”*

### *Objective:*

- To ascertain whether there are perceived benefits of using the vMe in a learning environment*

**Comment:** *The motivating factor behind the research was to provide a mechanism for learners to interact with an individual’s content. The following questions look at whether the framework or part of the framework would provide benefits for users in their learning.*

There are several features in the virtualMe system that are designed to be used in a blended (mixture of face-to-face and online) teaching and learning environment

	(Please circle)				
	Useless	Not useful	Useful	Very useful	Don't know
Using virtualMe for my teaching/study would be ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To improve performance in my teaching/study, using virtualMe could/would be ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To improve productivity (save time, work, etc.) in my teaching/study, using virtualMe could/would be ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To enhance effectiveness in my teaching/study (for example, improves your capability of achieving the goal of delivering your course or getting your qualification), using virtualMe could/would be ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I had access to virtualMe in the future, I think would find it ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please list any features you found useful. <i>Comment:</i>
Please describe which feature you consider to be most useful. <i>Comment:</i>
Please list any other features you did not find to be useful. <i>Comment:</i>
Please describe which feature you consider to be least useful. <i>Comment:</i>

Please add any other comments, if you wish:
---

## D.8 Questions for ease of use

*Comment: As part of validating the virtualMe framework the TAM model considers ease of use as a significant factor. While the prototype is not user friendly in terms of creating content, it does provide the functionality that shows how such a framework would operate. Therefore, the focus will be on the ease of use as a content delivery mechanism rather than in the creation of that content.*

The following questions look at ease of use for the virtualMe framework.

### Overall framework

In relation to displaying content (1, 3)

	(Please circle)				
	Difficult	Not easy	Easy	Very easy	Don't know
Understanding the relationship between the menus, the snippets and the media elements was easy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Viewing content did not require a lot of mental effort.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understanding the difference between overhead view, page view and printout view was easy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Viewing a media element in different ways was easy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please add any other comments, if you wish:

### Annotation framework

In relation to adding annotations

	(Please circle)				
	Difficult	Not easy	Easy	Very easy	Don't know
Adding annotations is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Adding out of context annotations (messages) is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Adding in context annotations (attaching an annotation to a snippet) is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reviewing and replying to annotations is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please add any other comments, if you wish:

## Resource acquisition, management and sharing at source

In relation to sharing content

	(Please circle)				
	Difficult	Not easy	Easy	Very easy	Don't know
If I had access to a compatible system, the ability to copy a multimedia object (MMO) in my notes would be ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Displaying reference information for a piece of content was ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Displaying multiple representations for a piece of content was ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please add any other comments, if you wish:

## Teaching & Learning

In relation to using as a training tool (use of training videos, teaching material)

	(Please circle)				
	Difficult	Not easy	Easy	Very easy	Don't know
Using the system was ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using the system to learn a new software application was/would be ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using the system to learn theory content was/would be ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using the system to display lecture material (using overhead view) was ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please add any other comments, if you wish:

## D.9 Questions to determine user's experiences (to assess bias)

The system used to demonstrate the framework is a prototype and as such there are things that may influence some of your responses. This section tries to get some idea of things that may have affected the way you looked at the questions in this survey.

*Comment: Bias exists in all surveys. This section looks at possible reasons for any bias. The questions are set out in an open format rather than structured to allow users to clearly identify any perceived bias.*

Please comment on any issues that you believe may have affected your responses. (For example, System (un)availability, responsiveness, use by peers ...).

If you were part of a class in which the system was used for teaching, do you believe the way your lecturer used the system influenced your responses? Please explain.


What do you think could be done in the system to address the issues you mentioned in above two boxes?

Do you prefer to complete a survey on-line, on a printed page or through email? Did this affect how you filled in this survey?

Finally, are there any other comments you would like to make that have not been covered in this survey?

Thank you for filling in this survey. If you have any further questions or comments feel free to email [mverhaart@eit.ac.nz](mailto:mverhaart@eit.ac.nz) or visit <http://www.virtualMV.com>

## D.10 Ethical Approval Massey

**Massey University**

16 August 2006

Michael Verhaart  
30 Busby Hill  
HAVELOCK NORTH

OFFICE OF THE ASSISTANT  
TO THE VICE-CHANCELLOR  
(Ethics & Equity)  
Private Bag 11 222  
Palmerston North  
New Zealand  
T: 64 6 350 5573/350 5575  
F: 64 6 350 5622  
humanethics@massey.ac.nz  
animalethics@massey.ac.nz  
gto@massey.ac.nz  
www.massey.ac.nz

Dear Michael

**Re: Evaluation of the Virtual Me: A Portfolio Framework for Acquiring Contextualised Data, Information and Knowledge at Source**

Thank you for your Low Risk Notification which was received on 16 August 2006.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.


**A reminder to include the following statement on all public documents:**

*"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research."*

*If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethics & Equity), telephone 06 350 5249, e-mail humanethicspn@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely




Sylvia V Rumball (Professor)  
Chair, Human Ethics Chairs' Committee and  
Assistant to the Vice-Chancellor (Ethics & Equity)

cc Assoc Prof Kinshuk  
Department of Information Systems  
PN311

Assoc Prof Chris Freyberg, HoD  
Department of Information Systems  
PN311

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Massey University Human Ethics Committee  
Accredited by the Health Research Council



## D.11 Ethical Approval EIT



HAWKE'S BAY

*Te Whare Tokiura o Kaitiaki*

14 September 2006

Michael Verhaart  
Faculty of Business & Computing  
EIT Hawke's Bay  
TARADALE

Dear Michael

Your application for research approval on "Evaluation of the Virtual Me: a portfolio framework for acquiring contextualized data, information and knowledge" (Ref. No. 14/06) was evaluated by two members of the Research Committee.

I am pleased to inform you that your project is approved as a low risk for a period of one year from the date of this letter. However, you are reminded that under Section 6 on page 6 where you imply to interview lecturers and learners needs to be spelt out if you decide to do this.

It is noted that this application was approved by Massey University as the institution of your study.

I would like to wish you all the best with your project.

Ami Sundar (Dr)  
RESEARCH CONVENER

### EASTERN INSTITUTE OF TECHNOLOGY

MAIN CAMPUS Gloucester Street, Private Bag 1201, Taradale, New Zealand. Telephone 06 974 8000, Facsimile 06 974 8910  
Web [www.eit.ac.nz](http://www.eit.ac.nz) Email [info@eit.ac.nz](mailto:info@eit.ac.nz)

HASTINGS CENTRE Cor Lyndon & Railway Roads, PO Box 1477, Hastings. Telephone 06 878 4738, Facsimile 06 878 2965

CENTRAL HAWKE'S BAY CENTRE 53 Russell Street, PO Box 230, Waipukurau. Telephone 06 858 7009, Facsimile 06 858 7018

FLAXMERE CENTRE Flaxmere Village, Swansea Road, Flaxmere. Telephone 06 974 8943

Wairoa CENTRE Cor Paul & Queen Streets, Wairoa. Telephone 06 838 7549



## E The virtualMe survey – results

This appendix contains a copy of the summary produced from the online survey. As blank (where respondent did not provide any response) and “don’t know” response provide no information as to whether the respondent agrees or disagrees with the statement, n is calculated **excluding** Blank and Don’t Know. This analysis is based on the data as at the 19<sup>th</sup> September 2007 and the total number of respondents was 57. Apart from replacing any identifying comments with xxx, and indicating duplicate entries with a (x nn), the text is as entered by the respondents.

### E.1 Survey results

#### 1. Something about you.

**This section will help me to understand your point of view.**

Please indicate if you are a student in one of Michael's classes or are working closely with him (As an example, someone working closely would be in Info Technology at EIT or a Massey Supervisor).

- Grad Dip Teaching Student
- An Ex student of EIT as well as of Mr. Michael Verhaart...I am really glad that you are still in touch with me though i am far off sitting in Mumbai, India
- Student but also work at EIT
- I am a current student of Michael
- student at Massey
- Ex EIT BCS Student
- Hi, Michael, this is xxx of xxx Systems, Inc. Keep it simple makes the most sense. Likely we'll go with a very simple, human-interface-analyst designed interface to collect data from job performers, and leave the computer-based analysis and text summary approach for another year.
- Previously and EIT student
- Was a student (suppose i still am as im still on the roles) but graduated / did the last assesment 3 weeks ago.
- I am a ex student of EIT and Michael was one of my lecturers
- past student

18 : A  
student of  
the author  
4 : Closely  
work with  
Michael  
35 : Other

57

Please indicate how you have interacted with virtualMe

If *other* please specify :

**Note:** In order to complete this survey it is necessary that you have at least examined the online virtualMe system.

Click on the following link to access the site if you have not...

<http://www.virtualMV.com>

- Just briefly - are those two snippets on PowerPoint? Is that what I was looking at?
- Massey WebBased MM 157730 (x 11)
- Yes I have used virtualMe and found it very useful watching the video clips and applying it to my work.
- I went through the system and looked at most of the available items
- Taught classes using it.

10 : Examined

5 : Tested

19 : Used

21 : Seen a demonstration

2 : Other

57

Please indicate to which group you belong

(Please check all that apply.)

If *other* please specify :

- Your interviewer!!
- Michaels Multimedia ex-student
- Work at EIT and Ex BCS Student
- PhD student / researcher
- Knowledge Transfer Manager for Rockville, MD, USA based systems integrator

41 : Student

13 : Educator

5 : Visitor

6 : Other

65

Please indicate your level of computing confidence

1. A novice would rarely use a computer, maybe to clear emails or use a word processor or equivalent
2. An ok user is happy working on a computer but seeks help when needed
3. A confident user would be able to use a computer managing files, downloading from the internet and using a variety of applications
4. A proficient user would be able to happy to provide assistance to others
5. An expert would create software, and would be considered a power user.

1 : 1.Novice

2 : 2.Ok

11 : 3.Confident

26 : 4.Proficient

17 : 5.Expert

0 : Blank

57

What is the highest qualification that you have or are studying for?

If you are not sure what to choose, use *other* and please describe.

- Diploma
- Bachelor of Computing Systems (BCS)
- master in Information Systems
- Bachelor of Computing (BCS)
- Diploma in Information and Communication Technology
- PhD student & Instructor
- Prof at Athabasca Univ.
- working towards a diploma
- PhD student
- Information Systems
- Dip Bus, Dip Acc, Dip OA
- NZIM Management Cert
- PhD maori education

1 : Non Tertiary

21 : Degree

23 : Postgraduate

11 : Other

1 : Blank

57

## Appendix E

Identify the main domain you study/work in (For a student what area you are studying, for a lecturer your main teaching area)?

For example, Information Technology (IT), Science, Arts, Health, Trades, ...

- Information Technology (IT) x 21
- Marketing and Management
- Information Management
- Distance Education
- educational technology
- Vehicular Director -- Transport
- BBS/BCS
- English language (ESOL)
- Education
- Computer System
- Maori Education indigenous research.
- Arts
- Health
- Information Technology, with emphasis on systems-mediated collaboratory work among geographically dispersed locations
- Grad dip in Tchg (sec)
- Communication
- Knowledge Transfer
- Educational Technology (Background in Information Systems)
- Multimedia and Web Development
- Legal firm as an Business Consultant
- Human job-based training and performance support.
- Science / Staff Development
- IT - Technician
- Information Management

What age range are you in?	0 : <20	57
	22 : 20-29	
	13 : 30-39	
	12 : 40-49	
	9 : 50-59	
	1 : 60-	
	0 : Blank	
Are you male or female?	29 : Male	57
	26 : Female	
	2 : Blank	

Please indicate which country you are a citizen of ( if more than one choose which you identify most with, and add a comment if you wish. ) <ul style="list-style-type: none"> <li>India</li> <li>Maori</li> <li>New Zealand</li> <li>New Zealand</li> <li>NZ</li> <li>... at least now I think you know who I am :)</li> <li>NZ</li> </ul>	1 : Austria
	1 : Canada
	7 : China
	1 : Malta
	30 : New Zealand
	1 : South Africa
	2 : Taiwan
	3 : United States
	1 : Zimbabwe
	10 : Blank

What type(s) of personal web presence do you have? (Please check all that apply.) If other please specify : <ul style="list-style-type: none"> <li>Also on Saachi London Gallery web site</li> <li>National network</li> <li>Company web</li> <li>WAYN</li> <li>Ringo, Yahoo Groups</li> <li>WAYN</li> </ul>	16 : None
	3 : Wiki
	11 : Blog
	13 : MSN Spaces
	4 : MySpace
	7 : BeBo
	17 : Personal Web
	7 : Other

## 2. Questions for perceived usefulness

### Overall framework

The virtualMe presents a framework in which many features are demonstrated. For each of the following statements please rate in order of usefulness.	Useless	Not Useful	Useful	Very Useful	Don't know	Blank	n
<b>Notes:</b> A <i>Sniplet</i> is a piece of content that can be displayed on one overhead projection. Don't forget to [Save] regularly.							
The ability to view content in a page layout is ...	0	1	18	33	0	5	52
The ability to view content in a display (overhead) layout is ...	1	1	19	30	1	5	51
The ability to combine content into a continuous view suitable for printing is ...	0	0	16	33	3	5	49
The ability to include content in many places (for example, a sniplet describing the gif file format can appear in notes for web and multimedia) is ...	0	0	22	30	1	4	52
The ability to customise your interface (Select icons, text or both, change the look, e.g., colours) is ...	0	7	23	21	1	5	51
To have referencing information available on each page is ...	0	2	15	33	2	5	50
The “feeling” that I am interacting with a person rather than content is ...	0	9	22	20	1	5	51
The “feeling” that I am part of a network of users is ...	0	5	28	17	1	6	50
One goal of virtualMe is to give the impression that you are conversing with an individual. To this end, the user interface can be changed, personalised images can be included, and messages from the lecturer can be sent. I find these personalisation features of virtualMe were useful to place the content in a context (i.e. gave the content meaning) is ...	1	5	18	24	1	8	48

Please list and/or describe any other features you found/find useful (or you think would/will be).

- good lay out easy to find information as needed
- object with context
- I thought the navigation was great. Both the crumtrail and the progression balls made it plain where I was at in the MMO.
- Folder view of items (would be). Seeing objects in a container (is).
- 1. content category of this sys
- \*)I like that there is a opportunity to view Wiki and OHG and create a wiki for each page \*) Option to add meta-data to the page and to show it to others (distinguishing between different groups of users)
- The breakdown of how to do applications set out clearly on your website. HTML in specific.
- An ability for users to interact with one another - perhaps in a user forum sense. (Being fair its been sometime since I used VirtualMV, so this may have been included already).
- Annotations,
- website linking, full and/or multiple referncing of objects
- i think it would be a good idea to have less on the pages and display pages more simply with the content rather than having boxes for adding notes at the bottom of each page, it would be good to hide that feature unless it is required. I also think that the formatting could do with some revamping. the site does not look very professional and up to the standard that it is suppost to support.
- breadcrumbs (though they did not seem to work everywhere), toolbar
- A virtual classroom
- pictures/video/adding comments to the virtualMe
- Its ability to package mm objects together.
- personalization
- instant messaging, so u can see whos online and communicat with them
- I like the overhead transparency view.
- Ability to book mark highlite sections When you are in a page/file it would great to be able to see in the margin where exactly you are in Vme. eg Tree diagram. It was/is possible to get a bit lost.

Please list and/or describe any other features you did **not** find to be useful.

- The fact that the site has so much going on that, its confusing in some ways. Having to select multipule buttons etc, links you dont know where to go next.
- none
- pictures if napier :-p
- None
- Some pages did appear somewhat "busy" - much content displayed in an irregular fashion
- I don't like the navigation in the system. The symbols are nice but it would be more useful if it is possible to go to the next object regardless of the present position in the course. Now, if it is the last object in a sub-chapter, I have to go back to the outline and go manually to the next sub-chapter.

## Appendix E

Please add any other comments, if you wish:

- I need to revisit the site again
  - Any interface is useful when it tells me where I am and what to do. I didn't know either on the snippet interface.
  - The idea of personalisation is a nice way to feel you are interacting with a person, not a machine. However I don't think that these provide context - I think the other features are more useful at providing context.
  - After the technical work has been done, it might be good to get professional web designers to optimise the appearance of the site, especially if user-friendliness is an objective.
  - Excellent Work Michael....Thankyou for mailing me and letting me know about this...i hope all our lectures would also be like this virtually where u don't physically have to be in a class and ppl like me and study under you from India and not come all the way to NZ
  - Some general comments: \*) Links to Newsletter and personal profile does not work \*) Speed is really sometimes slow! \*) the navigation menu with the symbols (for going to the next page) seems to have some small problems at: Course about Internet: sometimes it's left and sometimes right. \*) Login for survey does not work when I go via your system.
  - An insightful tool for teaching and learning
  - Very exciting webpage.
  - I think the content is what is important. I do believe that the site has so much focus on extra that it moves away from easy functionality and therefore would be a challenge to users with no experience.
-

## Annotation framework

There are several features in the system allowing content to be entered in context. For each of the following statements please rate how useful it is.	Useless	Not Useful	Useful	Very Useful	Don't know	Blank	n
The ability to target an annotation to a specific user is ...	0	1	22	26	2	6	49
Messages to/from the virtualMe are ...	0	3	23	25	0	6	51
Messages to/from everyone are ...	0	4	26	20	1	6	50
Messages to/from a specific individual (other than the virtualMe) are ...	0	1	27	21	2	6	49
Messages to yourself (reminders, side notes) are ...	0	2	19	30	0	6	51
The ability to annotate each snippet is ...	0	1	19	30	1	6	50
To be able to copy of a piece of content and make private changes (Wiki) is ...	0	0	26	24	1	6	50
Adding a comment to a specific media element such as an image is /would be ...	0	0	23	28	0	6	51
Annotations that are text based are ...	0	0	29	20	2	6	49
Annotations that are multimedia (images, audio, video) are ...	0	3	22	26	0	6	51
The ability to have content changed over time due to adding annotations is ...	0	1	14	36	0	6	51
Annotations generally are ...	1	2	24	23	1	6	50

Please add any other comments, if you wish:

- \*\* How do I save the survey at this point? \*\*
- having the ability to do any of the above is useful, but in saying that who really would care. its the site creator who would get more use out of these features not so much the user.
- I am not sure the virtualMe achieved the 'content in a context' for me.
- I think the concept is very useful. I wonder how it will be kept 'cleaned up' though?
- They are all important features from my point of view
- For me, annotations of any kind seem to be useful but that's more from a research point of view. I cannot say whether and how often I would really use it also. But it's nice to have the option!
- Please be careful not to overdo the annotations. Useful as a guide only
- Automatic linking of annotations to a reference (repository) wiki for assisting in maintaining (editing) that repository [and serve as interim updates]



## Resource acquisition, management and sharing at source

	Useless	Not Useful	Useful	Very Useful	Don't know	Blank	n
To have meta-data, referencing and digital rights information available for each media element is ...	1	2	22	23	0	9	48
The ability to drill down on each media element to see additional information is ...	0	3	18	26	1	9	47
To be able to display a media element in a variety of ways is ...	0	0	22	26	0	9	48
I would find the ability to copy a media object that contains contextual information such as author, ownership and a description ...	0	2	25	20	0	10	47

Please add any other comments, if you wish:

- Would this [need to] tie into a digital right manangement framework?
- I need to revisit the pages again

## Teaching & Learning

	Useless	Not Useful	Useful	Very Useful	Don't know	Blank	n
There are several features in the virtualMe system that are designed to be used in a blended (mixture of face-to-face and online) teaching and learning environment							
Using virtualMe for my teaching/study would be ...	0	1	19	27	3	7	47
To improve performance in my teaching/study, using virtualMe could/would be ...	0	0	20	27	3	7	47
To improve productivity (save time, work, etc.) in my teaching/study, using virtualMe could/would be ...	1	4	18	23	4	7	46
To enhance effectiveness in my teaching/study (for example, improves your capability of achieving the goal of delivering your course or getting your qualification), using virtualMe could/would be ...	0	1	21	24	4	7	46
If I had access to virtualMe in the future, I think would find it ...	0	3	17	26	3	8	46

Please list any features you found useful.

- documentation I can refer to at any time
- The multimedia/text/annotation combination is very useful for aiding students in grasping difficult concepts.
- Generally interesting, but not sure it is compelling enough to get my references out of Procite, or my presentations out of Powerpoint. Need to think about ways to integrate and make transition to use of the product. Interesting work
- easy to use, practicality

- Monitoring use by individuals. Communication with users regarding specific teaching points.
- Add annotation, send message, display various contents
- video of a lecture so I can go over it again
- metadata on files
- objects with context
- Annotations, OHT, Maintaining Context, Consistent Navigation, Printing, Managing References, Snippet Reusability
- Information links
- Use of multimedia step-by-step guides for many procedures (e.g. animating gigs). Ability to alter display formats of information pages helpful if initial display format not suited to learning style
- tying resources together References
- The OHT display as well as the note display
- The lectures that stored in the database can be displayed as ppt or just word
- i believe that the information is concise, so i would use it and find it useful, only because i need to be in the site not because i want to be.
- I'm doing a lot of research with learning management systems. The difference is that these systems provide other features. They do not focus on issues like annotations and so on but they provide also some other interesting features like quizzes. I think it depends on the intention, to decide for one system. Regarding productivity, I don't believe that teachers save time with online systems.
- ability for students/others to annotate ability for student to see materials in different views can customise using my preferences can share resources
- Simple easy links to the information

Please describe which feature you consider to be **most** useful.

- metadata on files
- The conversion factor so that bullet pointed information can be displayed to keep attention
- Annotations, snippet reuse are very useful.
- same as above (objects with context)
- I think the MMOs are especially useful in the computer science realm. There are so many concepts that are difficult to get across.
- snippets
- Annotation
- Above
- I like the idea of having the change to put comments on a page
- Use of multimedia
- The feature I listed above (The lectures that stored in the database can be displayed as ppt or just word)
- Feedback from students
- Annotations (to promote constructivist learning mode)
- concise details of a subject, information specific to my learning needs.
- The personalised aspect of this e-learning tool.
- The MMO
- Video/pictures
- The video's
- display various contents

Please list any other features you did **not** find to be useful.

- the drill down depth is quite large
- None
- I probably would not need to reference every object, unless required to by law.
- None
- wiki
- -
- none

## Appendix E

- I think drilling down and being able to display a mmo in mutliple ways is a nice-to-have in terms of use for everyday teaching, but drilling down can be very useful to provide context.
- i do not find the site very useful to use other than content. the site is not useful when it comes to navigating or trying to find something. it not always clear where i need to be or what area the information is in, some content is hidden. The feature that allows you to add notes and such at the bottom of each page is just not useful at all.
- Some information not presented in easy flowing formats. Some interpretation by user required
- I thought the pages had too many features

Please describe which feature you consider to be **least** useful.

- Pictures on the front page.
- The feature that allows you to add notes and such at the bottom of each page is just not useful at all. the navigation buttons are not useful you really would not have any idea to use them if you are a new user.
- None
- -
- Printing

Please add any other comments, if you wish:

- The scope of using multimedia opens so many avenues for making courses interesting, resourceful and interactive
  - I lost comments on the save. Scrolling up to the top of a page to SAVE is not helpful.
  - I do believe the site does need upgrading to a more professional and cleaner looking environment. the more busy it gets the less appealing it is becoming.
  - Overall a helpful and potentially very informative site - both as a teaching resource and a student resource
  - Session timeout was too short for typical usage in virtual classroom
-

### 3. Questions for ease of use

The following questions look at ease of use of the virtualMe framework.

#### Overall framework

In relation to displaying content	Difficult	Not easy	Easy	Very Easy	Don't know	Blank	n
Understanding the relationship between the menus, the snippets and the media elements was easy.	1	7	31	8	0	10	47
Viewing content did not require a lot of mental effort.	2	6	27	12	0	10	47
Understanding the difference between overhead view, page view and printout view was easy.	0	7	29	10	0	11	46
Viewing a media element in different ways was easy.	2	5	31	8	1	10	46

Please add any other comments, if you wish:

- I couldn't tell that there were multiple views.
- It was fairly easy to understand while it was being demonstrated, but I didn't grasp the intended point of it when I has a brief tour by myself.

#### Annotation framework

In relation to adding annotations	Difficult	Not easy	Easy	Very Easy	Don't know	Blank	n
Adding annotations is ...	1	2	21	15	6	12	39
Adding out of context annotations (messages) is ...	2	4	22	8	9	12	36
Adding in context annotations (attaching an annotation to a snippet) is ...	1	2	25	9	9	11	37
Reviewing and replying to annotations is ...	1	3	24	11	7	11	39

Please add any other comments, if you wish:

- Fo me I have not done this
- instrucciones . . . no habia instrucciones . . .
- I had a couple of false starts due to tiredness more than anything but once used to the system found it easy

## Resource acquisition, management and sharing at source

In relation to sharing content	Difficult	Not easy	Easy	Very Easy	Don't know	Blank	n
If I had access to a compatible system, the ability to copy a multimedia object (MMO) in my notes would be ...	0	4	28	7	6	12	39
Displaying reference information for a piece of content was ...	0	4	23	13	4	13	40
Displaying multiple representations for a piece of content was ...	0	3	27	9	5	13	39

Please add any other comments, if you wish:

- I need to revisit the page
- User friendly
- The implementation of RLOs is excellent.
- I really need to use and try out more

## Teaching & Learning

In relation to using as a training tool (use of training videos, teaching material)	Difficult	Not easy	Easy	Very Easy	Don't know	Blank	n
Using the system was ...	0	3	27	9	4	14	39
Using the system to learn a new software application was/would be ...	0	3	28	7	6	13	38
Using the system to learn theory content was/would be ...	1	4	24	11	3	14	40
Using the system to display lecture material (using overhead view) was ...	0	3	18	18	5	13	39

Please add any other comments, if you wish:

- same as above reason (I really need to use and try out more)
- I need to revisit
- I think activities like exercises would be more useful to learn to do something practical, but snippets could be set up as activities (e.g. instructions to "do this").
- I haven't used the system yet.
- Found I could get lost if not aware of what had already looked at.
- only from what I saw when going through the material (I did not took a course)
- Training includes presentation + practice + feedback, minimally; preferably + motivation + evaluation. No practice - this was not training.
- Its great that you can assess your learning material from home via internet.

#### 4. Questions to determine user's experiences (to assess bias)

The system used to demonstrate the framework is a prototype and as such there are things that may influence some of your responses. This section tries to get some idea of things that may have affected the way you looked at the questions in this survey.

Please comment on any issues that you believe may have affected your responses. (For example, System (un)availability, responsiveness, use by peers ...).

- Selection of Browser - I am aware that a number of sites may not display or behave as well under my current browser, Opera. This may or may not have an effect on my use of vMe.
- I need to experience system more to give some of the answers
- I have used the system and also seen others use the system and they have the same type of difficulty
- no
- Look and feel is a bit "dated", but I disregarded this when answering.
- Besides the internet running slowly, there are no issues which affected my responses
- Get lost in it. eg not knowing where your where relative to whole body of learning for a chapt or area
- See comment below
- Instructional design & human performance technology background.
- None
- none my own thoughts from personal use
- not physically using system makes answering difficult
- no probs
- Some features were not implemented consistently on all pages (e.g., breadcrumbs); this is obviously a work-in-progress.
- This system was used alot during the course of my 3 year study. This system contains very useful information about the computer age - Website & design
- Interactive, availability
- The layout/design on the pages could use a little polish. The underlying functionality is far more powerful than the amateur page design suggests.
- Some pages loaded slowly/took a while to load.
- I don't know, the system was little bit slow but I don't really mind about that

If you were part of a class in which the system was used for teaching, do you believe the way your lecturer used the system influenced your responses? Please explain.

- N/A
- not applicable
- I was not
- No. The lecturer was very clear, concise and went through the site at a relative pace to the class ability
- not applicable
- lecturer influenced for student how to improving study technical
- Micheal was very enthusiastic... and it is infectious. I enjoyed his presentation and want his system to be successful.
- No probably the opposite to give honest responses
- No we were advised to look at the system
- NA
- Yes. This system was very effective teaching tool. It is self teaching and made me as a student become proactive.
- Yes - was suprised at depth of material present on site
- No not really, these responses are from my own use of the system.

## Appendix E

- Yes I liked the content and context.
- No, the system was used to help us learn.
- As we were only given a one hour overview of the use of the prototype I believe this site proved easy to utilise. I have a reasonable background in IT including creating webpages/sites on an amateur basis. I intend investigating the source code for some of the pages within this site to learn how certain features have been constructed.
- Yes, easy to understand
- No. Except perhaps being that Michael is always extremely excited about his vMe project and therefore it is hard not to get excited along with him and I probably used it more because of this.
- Yes, this is the only way we saw it
- No. Was an excellent way to deliver info for practice tutorials.

What do you think could be done in the system to address the issues you mentioned in above two boxes?

- I have no further comment as selection of browser may well not be an issue - I do not use anything except Opera.
- -
- I believe the system needs a cleaner layout, with a more better navigational system in place. A professional layout with less functionality and options available to us. Most of the feature really only benefit the user or lecturer not the students. the content is all that we need from the site not the extras.
- N/A
- try to get the system faster ... but I know that you already work on this issue ;)
- Update CSS, and have recent photos only
- Acquire funding for a professional systems development team and a project manager
- Get some assistance from someone with a high level of graphic design skills... although this is obviously a nit-pick in the general scheme of things. The functionality of the system is very good.
- learn more difference stuff
- time to use it
- Setup a twin system, one is for real teaching and students who will evaluate VMe, another is for other visitors.
- A greater use of icons may help for people with limited IT confidence.
- N/A

Do you prefer to complete a survey on-line, on a printed page or through email? Did this affect how you filled in this survey?

- |  |  |           |
|--|--|-----------|
| <ul style="list-style-type: none"> <li>• no effect - this is how I did it.</li> <li>• Yes I would like to complete a survey online but I had to fill this form</li> <li>• i would prefer on-line</li> <li>• online. Yes, I am more likely to spend time answering the questions more completely.</li> <li>• online is best for me</li> <li>• Indifferent anyway.</li> <li>• Need to be able to look at virtualMe</li> <li>• No effect</li> <li>• Online is more efficient, as it can be done straight away and no extra hassles.</li> <li>• Online</li> <li>• NO</li> <li>• Online. I feel it's faster and I'm more comfortable with it, perhaps because I very infrequently use antiquated pens and pencils.</li> <li>• No particular effect, other than making completion more likely.</li> <li>• not at all.</li> <li>• No</li> <li>• Online survey.</li> <li>• online</li> <li>• prefer online after I have really used the website myself</li> <li>• on line more efficient</li> <li>• Online, thei did not affect the way I completed the form</li> <li>• online just was easier, maybe got rushed more then it would have if it was a printed version. beacause when online we go at 10000000 miles an hour.</li> <li>• Being able to use radion buttons made the online response easy.</li> <li>• I prefer printed page because I normally spen more time on reading printed materials.</li> </ul> | <p>35 : Online</p> <p>2 : Printed</p> <p>1 : Email</p> <p>19 : Blank</p> | <p>38</p> |
|--|--|-----------|
-



Finally, are there any other comments you would like to make that have not been covered in this survey?

- "S" for Simple - great work Michael!!!
- Nice concept
- As a (busy) teacher, I would like any system to be efficient in terms of time needed to prepare for the presentation of lessons or work for individual students. Also, it must be fairly intuitive for students to use. I would probably use it more to assign or offer work after class than during as I teach English which is best taught face-to-face but which could be well supported by relevant computer-based material.
- It is a great system, easy to use and holds very helpful information. The system simply needs to be more enjoyable to view.
- I believe this is the way of the future.
- I would like to see this developed into a [please pardon the term] commercial product, as it addresses some shortcomings that I see in the LMS products with which I am familiar (i.e., Blackboard, ANGEL, WebCT, Sakai).
- no
- At this stage I only saw you demonstrating the system. The pages look crowded - lots of stuff in one page. Maybe it would be nicer and tidier if you make it simpler (The pictures on the left, do they mean something to the system?) Note: Michael, most questions for ease of use, I still leave blank because I think it would be good to try it first. I'll complete later when I have tried it.
- Thank you, much, Michael, for pointing me to this application!
- Nice to see such a professional look to the site now... begone evil green and several variations of pink!
- no
- Great work Michael, keep it up.
- Michael I will take time to read over the printed version of the tour - yes I'm one of those hard copy freaks - and I will return with other comments when I have a better handle on what you are doing - the potential for application in education in our future is huge I'm sure you are aware of that!!! This survey format is also very easy to use and very clear I appreciate that very much. Best of luck with your research I am very interested to see the results as you put them out to everyone. regards xxxx
- the website had lots things can learn from
- -
- The system is a great idea and I particularly like the anotations. I also like the concept of making the system seem more "alive" and personal. I really like the sniplet reuse, because so many topics cross over different courses, and this way the annotations from one course are available to another.
- excellent system. I especially like the MMOs regarding computer graphics. My school has a tough time teaching this course at a distance - this would be a huge benefit to that course. (And I could see the same thing for most of the COMP courses.)
- This is an awesome system providing students with reference points and a wealth of information for their courses
- I would like to point out that the site is useful as a teaching aid, but for a student resource it is a little confusing to use sometimes.

## **F            Publication list with abstracts**

In order to support and validate the research, findings have been extensively published in books and journals, and presented in conferences and workshops. This appendix contains a list of relevant publications and presentations with their references and abstracts.

Table F-1 displays a summary of the publications and presentations and indicates how these relate to the virtualMe framework. There is an additional column “related” to indicate that the work supported the development of the ideas associated with the framework, and an “O” indicates which of the areas the publication referred to.

In addition, the research has been regularly presented to peers at postgraduate seminars arranged at Massey University.

Year / month	Publication	virtualMe	User profile	Taxonomy	Sniplet	MMO	MVML	Annotation	Teaching & learning	Survey	Related
2002/07	NACCQ, Hamilton, NZ				○						☑
2002/12	ICCE, Auckland NZ				☑						
2003/06	EdMedia, Hawaii			☑	☑						
2003/06	Massey Technical report, NZ			☑	☑						
2003/07	NACCQ, Palmerston Nth, NZ				☑						
2003/08	(IF)ETS, (forum/paper)				☑						
2003/11	ETS, Journal article (ANICAM)					○					☑
2004/03	NACCQ, BACIT (journal)				☑						
2004/06	APCHI + Lecture Notes, Rotorua, NZ			☑	☑	☑	☑				
2004/07	Pan Commonwealth forum, Dunedin, NZ			☑	☑		☑		☑		
2004/07	NACCQ, Christchurch, NZ				○				○		☑
2004/08	ICALT, Finland			☑	☑		☑				
2005/03	PISA (workshop) Palmerston North, NZ							☑			
2005/07	NACCQ, Tauranga, NZ								○		☑
2005	Fuzziness (book chapter)	☑	☑	☑	☑	☑	☑				
2006/07	DEANZ, Auckland, NZ	☑				○					☑
2006/07	ICALT, Netherlands	☑			☑			☑	☑		
2006	Cognitively Inf. Systems (book chapter)					☑	☑				
2006	Encyclopedia (chapter)	☑			☑	☑		☑			
2007/07	ACM CHINZ, Hamilton, NZ					☑	☑			☑	
2007/07	NACCQ, Nelson, NZ	☑				☑			☑	☑	
2007/10	eLearn, Quebec City, Canada	☑			☑	☑			☑	☑	
2007/10	Athabasca University, Canada (seminar)	☑			☑	☑		☑		☑	
2007/12	NACCQ, BACIT (journal)								☑		
2008	NACCQ, JACIT (journal)	☑	☑	☑	☑	☑	☑	☑	☑	☑	

Table F-1: Publications and their relationship to the research

## **F.1 Book chapters**

### **F.1.1 Assisting cognitive recall and contextual reuse by creating a self-describing, sharable multimedia object.**

Verhaart M., & Kinshuk (2006). Assisting cognitive recall and contextual reuse by creating a self-describing, sharable multimedia object. In E. M. Alkhalifa (Ed). *Cognitively Informed Systems: Utilizing Practical Approaches to Enrich Information Presentation and Transfer*. Idea Group Inc. pp 50-73 ISBN 1-59140-842-3 <http://www.idea-group.com/books/details.asp?id=5535>

#### **ABSTRACT**

Digital media elements, or digital assets are used to illustrate things such as images, sounds or events. As humans, we use many senses to assist our cognitive processes, and providing multiple representations will enhance our ability to store, recall and synthesise the knowledge and information contained in the digital asset. This chapter introduces a model for a multimedia object, that allows multiple representations to be managed, and includes a structured meta-data file describing the asset that captures the original context. Humans are capable of classifying and describing millions of such objects, but recalling context and content often blurs over time. Computer systems provide us with a way to store electronic objects, and with a variety of representations and sufficient meta-data they can be used to assist cognitive recall.

### **F.1.2      A dynamic personal portfolio using web technologies**

Verhaart M., & Kinshuk (2006). A dynamic personal portfolio using web technologies. In C. Ghaoui (Ed). *Encyclopedia of Human Computer Interaction*, pp 170-174, ISBN: 1-59140-562-9, Idea Group Reference ( <http://www.idea-group.com/encyclopedia/details.asp?ID=4467> )

#### **INTRODUCTION**

With the ubiquitous availability of the Internet, the possibility of creating a centralized repository of an individual's knowledge has become possible. Although, at present, there are many efforts to develop collaborative systems such as wikis (Leuf & Cunningham, 2002), Web logs or blogs (Winer, 2002) and sharable content management systems (Wikipedia, 2004), an area that is overlooked is the development of a system that would manage personal knowledge and information. For example, in an educational setting, it has been found that most lecturers customize content to suit their particular delivery styles. This article outlines a framework that uses Web technologies allowing the storage and management of personal information, the sharing of the content with other personal systems, and allows for annotations to be captured *within context* from people who visit the personal knowledge portfolio.

### **F.1.3            Developing a user centered model for creating a virtual learning portfolio**

Verhaart M. & Kinshuk (2005). Developing a user centered model for creating a virtual learning portfolio. In Ghaoui, C.; Jain, M.; Bannore, V.; Jain, L.C. (Eds.), *Studies in Fuzziness and Soft Computing*, Vol 178, pp 203-232. ISBN: 3-540-25045-X, ISSN: 1434-9922 (Paper) 1860-0808 (Online). Springer-Verlag.  
Electronic: [http://dx.doi.org/10.1007/11399520\\_8](http://dx.doi.org/10.1007/11399520_8)  
Hardcopy: <http://www.chemport.de/sgw/cda/frontpage/0,11855,5-175-22-46826064-detailsPage%253Dppmedia%257Ctoc%257Ctoc,00.html>

#### **INTRODUCTION**

A common way in which our individual learning is managed is through the creation of a personal portfolio of facts, information, knowledge and insights. Traditionally this has been achieved through summarising content, discussion, observations, and/or organising them in a paper based or electronic system. With the huge explosion of content available, particularly on the World Wide Web, new techniques need to be developed to help manage this personal learning content.

This chapter discusses a personal content management framework, where individuals have the ability to create a personal electronic portfolio of their knowledge. This includes adding facts and information from instruction, research, discussion, experience, insights and feedback. If some or all of the components are adopted by instructors, learners and content suppliers, the ability to create and share knowledge will be greatly enhanced. Using web based technologies and its ability to be accessed by both the knowledge owner and authorized external users, from almost anywhere 24 hours per day, a Virtual "Me" could be created. Hence, the framework has been coined the "Me" framework.

Within this Me framework, content is structured using two models. The "Snippet" model that gives structure to the knowledge and a "Multimedia Object" (MMO) Model that allows related multimedia to be packaged with meta-data utilizing a proposed Media Vocabulary Markup Language (MVML).

The chapter will also provide a brief look at some of the prototypes that have been implemented and trialed to test proof of concept and associated observations.

#### **F.1.4 Collecting, organizing and managing non-contextualised data, by using MVML to develop a Human-Computer Interface.**

Verhaart M., Jamieson J. & Kinshuk (2004). Collecting, organizing and managing non-contextualised data, by using MVML to develop a Human-Computer Interface. In M. Masoodian, S. Jones, & B. Rogers (Eds.) *Lecture Notes in Computer Science*, 3101, 511-520. Springer-Verlag ISBN 3-540-22312-6. (<http://www.springerlink.com/index/R9CC8M5YTX964VXD>)

#### **ABSTRACT**

One aspect of information technology increasingly being researched is organizing and managing the huge repository of data and information available. This is particularly relevant in the context of the explosion in Internet use. As knowledge is gathered from the Internet the ability to retain and recall the knowledge is becoming more and more difficult and complex. Computer based techniques are often used to store and manage this data. Managing the data typically takes two forms; firstly cross-referencing to the original source as in a bibliography or reference list, or secondly collected by an individual, such as purchasing a book, creating a hard copy of a web page, and so forth. With the Internet, web based tools and techniques are frequently employed to manage this information. This may be by maintaining a list of links as in a portal to actual web content, by using the available web search engines, or saving the content into a personal electronic knowledge space.

This paper will look at the ways this knowledge could be collected and the smallest unit required to organize small pieces of data. The ability to map this into an electronic medium is then explored, and a prototype meta-data schema is then discussed. Finally, the Human-Computer Interface will be discussed that could enable the data to be organized in a variety of ways based on the meta-data schema.

## **F.2 Journal articles**

### **F.2.1 The virtualMe, an integrated virtual teacher framework**

Verhaart, M. (2008). The virtualMe, an integrated virtual teacher framework. In D. Joyce (Ed) *NZ Journal of Applied Computing and Information Technology (JACIT)*, 12(1), 81-90.

This is a revised and updated version of a quality assured paper that appeared in the 20th Annual Conference of the National Advisory Committee on Computing Qualifications (NACCQ 2007), Nelson, New Zealand. Samuel Mann and Noel Bridgeman (Eds).

An invitation to submit was received from the editors December 2007.

#### **ABSTRACT**

With an ever increasing integration of web technologies into our lives, there is a need to look at how to capitalise on this technology. In a teaching and learning environment students, teachers and administrators are increasingly embedding web technology into their daily work.

This paper describes research into an internet based, teacher centered framework that can be used in a teaching and learning environment. A web-based prototype is described that has been used to investigate what features are desirable in a web-based teacher focused information and knowledge framework, and a survey of existing and potential users is discussed in order to identify the perceived usefulness of the proposed framework.



## **F.2.2      Beyond HTML: Creating Extensible Teaching Resources Using Database and Internet Technology**

Verhaart, M. (2004, Mar) Beyond HTML: Creating Extensible Teaching Resources Using Database and Internet Technology, *Bulletin of Applied Computing and Information Technology* (BACIT), National Advisory Committee on Computing Qualifications (NACCQ), Vol 2(1) Retrieved February 13, 2008 from [http://www.naccq.ac.nz/bacit/0201/2004Verhaart\\_TeachRes.html](http://www.naccq.ac.nz/bacit/0201/2004Verhaart_TeachRes.html)

### **ABSTRACT**

In the past few years as internet technology has become an increasingly important delivery mechanism in teaching and learning computing subjects, active research has been undertaken in attempt to utilize the technology and improve the quality of the resources used by learners.

This paper discusses the development of a knowledge and content management system that is evolving to manage Learning Objects in a teaching environment. In the system, feedback mechanisms are being implemented to capture both lecturer and student knowledge and maintain the context of that knowledge.

### **F.2.3      Developing a capture of knowledge system based on sharable and self documenting learning objects**

Verhaart, M. (2003). Developing a capture of knowledge system based on sharable and self documenting learning objects. *Educational Technology & Society*, 6 (3), 1-16 Retrieved August 5, 2003 from: [http://ifets.ieee.org/periodical/6\\_3/1.html](http://ifets.ieee.org/periodical/6_3/1.html) (ISSN 1436-4522).

#### **ABSTRACT**

Today's organizations have well developed systems for capturing financial data and producing reliable and accurate information. An area that is often overlooked is the importance of knowledge held by individuals associated with the organization. This is also true in an educational setting, where learners can often contribute real-world and personal experiences.

The difficulty of capturing this knowledge provides many challenges, in both business and educational settings. In order to be of any use, this knowledge has to be captured at its source and easily disseminated among those who will be interested or affected by this knowledge. The World Wide Web may be a potential technology platform.

The research in progress looks at whether this data/information can be effectively and efficiently captured, managed and retrieved, in an educational context.

#### **F.2.4      Developing a capture of knowledge system based on sharable and self documenting learning objects**

Verhaart, M. (2003, October), AniCAM: Developing stream based teaching resources, *Journal of Educational Technology & Society*, Volume 6, Issue 4, 2003. Retrieved November 3, 2003 from: [http://ifets.ieee.org/periodical/6\\_4/index.html](http://ifets.ieee.org/periodical/6_4/index.html) .ISSN 1436-4522 (online), 1176-3647 (print)

### **INTRODUCTION**

In their paper “Applying Evolutionary Prototyping Model in Developing Stream-based Lecturing systems, Nian-Shing Chen and Shun-Yi Huang describe three models of course delivery. Synchronization mode, Brower capture mode and full screen capture mode.

In Synchronization mode four separate files are created by the lecturer (video stream, audio stream, teacher’s annotation and the associated html pages). Inconsistency in presentation on the student’s browser and special players for viewing are listed as some of the problems.

In the Browser capture mode the teacher captures the contents of the Browser into a streaming video file (e.g. WMV), records whatever is displayed in the browser space. The major drawback is that if the teacher wants to display say an application outside the area defined by the browser window it is not recorded.

## **F.2.5            Features of Online Learning Management Systems**

Blyth, D. and Verhaart, M. (2007, December), Features of Online Learning Management Systems. *Bulletin of Applied Computing and Information Technology* Vol. 5, Issue 2. ISSN 1176-4120. Retrieved April 5, 2008 from [http://www.naccq.co.nz/bacit/0502/2007Blyth\\_LMS.htm](http://www.naccq.co.nz/bacit/0502/2007Blyth_LMS.htm)

### **ABSTRACT**

This paper examines the features needed in an online Learning Management System (LMS) that will ideally produce the best learning experiences for its users. Features, or their lack thereof impact directly on the e-learner's educational experience. In combination with a system's usability, they could make or break a student's commitment to a course. In the pursuit of determining relevant and required features in an LMS, this paper looks at the needs of specific users. Typical users include learners, administrators, management, and tutors. It is the learners however with their particular psychological needs and varied technological competencies that are the key target for any LMS. Therefore this paper focuses on identifying their needs, as a means to discovering features needed (by the LMS) which will facilitate and promote a rich learning experience for them. Popular current offerings of online LMSs in New Zealand are also analysed to identify the features available from both learner/user perspective and management perspective - such as reports/statistics, and usability features. A number of pedagogical issues are discussed within the context of features available in New Zealand's popular LMSs.

## **F.3 Conference Proceedings and Presentations**

### **F.3.1 Implementation of a Multimedia Object (MMO) in a variety of web environments**

Verhaart, M. & Jamieson, J. (2007). Implementation of a Multimedia Object (MMO) in a variety of web environments. *8th Annual Conference of the NZ ACM Special Interest Group on Human-Computer Interaction*. 1-4 July 2007, Hamilton, New Zealand ([www.cs.waikato.ac.nz/chinz2007](http://www.cs.waikato.ac.nz/chinz2007))

#### **ABSTRACT**

The internet is an environment made up of many digital assets, including text, images, animations, audio and videos. Context is often managed by association, that is, the text on the web page provides a description of the digital-asset. However, this ad-hoc arrangement can lead to a loss of context for the digital asset, particularly if the element has no association with the text.

Benefits can be found in describing a digital asset in alternative formats. For example, an image of a person can be enhanced if a business card were attached.

This paper describes a model for describing digital assets, by creating a wrapper for the digital asset that is made up of a manifest containing descriptive data, and related files. Possible human-computer interfaces to existing software are described that allow the digital asset to be displayed on the internet.

### **F.3.2      The virtualMe: An integrated teaching and learning framework**

Verhaart, M., & Kinshuk (2007). The virtualMe: An integrated teaching and learning framework. *E-Learn*, Oct 15-19, 2007. Quebec City, Canada. <http://www.aace.org/conf/elearn/>

#### **ABSTRACT**

A modern teaching and learning environment includes many modes of delivery, including face-to-face, online and offline. The internet is evolving into a place where individualization has become common and connectedness a cornerstone, and this is emphasised in what has become known as Web 2.

How can this paradigm be used in a teaching and learning environment? A web based teaching and learning system centered on an individual would be consistent with this paradigm.

This paper investigates an integrated framework that has been developed for a teaching and learning environment that is centered on managing the information and knowledge of an individual teacher. Prototype web-based systems have been developed and trialed in an attempt to identify suitable features and functionality. The current prototype, termed the virtualMe, is described, and an analysis of responses from a survey of current and potential users is discussed.

### **F.3.3          virtualMe: A virtual teacher environment.**

Verhaart, M. (2007) virtualMe: A virtual teacher environment. *20th Annual Conference of the National Advisory Committee on Computing Qualifications*, Nelson, New Zealand. NACCQ

*The editorial panel for the 20th NACCQ conference carried out a double blind review process involving each paper being reviewed in full by five reviewers. The panel accepted 42% of papers. These percentages maintain the reputation as quality assured.*

#### **ABSTRACT**

With an ever increasing integration of web technologies into our lives, there is a need to look at how this technology can be capitalised on. In a teaching and learning environment students, teachers and administrators are increasingly embedding web technology in their daily work.

This paper describes research into an internet based, teacher centred framework that can be used in a teaching and learning environment. It describes a web-based prototype that is being used to investigate what features are desirable in a web-based teacher focused information and knowledge system. A survey of existing and potential users is discussed in order to identify the perceived usefulness of some of the dimensions of the framework.

### **F.3.4          An   annotation   framework   for   a   virtual Learning portfolio.**

Verhaart, M., & Kinshuk (2006). An annotation framework for a virtual Learning portfolio. In Kinshuk, Koper, R., Kommers, P., Kirschner, P., Sampson, D. G., & Didden, W. (Eds.) *Proceedings of the 6th IEEE International Conference on Advanced learning Technologies 2006* (July 5-7, 2006, Kerkrade, The Netherlands: IEEE Computer Society, 156-160. ISBN 0-7695-2632-2

*492 papers from 56 countries. Double blind peer reviewed by an international panel of at least two international expert referees. 136 papers were accepted as full papers (27.64% acceptance), 122 papers as short and 42 posters.*

#### **ABSTRACT**

As a person learns, a significant amount of information and knowledge is accumulated, and a challenge faced by both instructors and learners is the ability to maintain a personal portfolio that manages this. Traditionally a variety of physical media such as, photocopies, images, and books were collected and personal observations and annotations were added. As electronic technology has advanced particularly on the internet, this has created some interesting opportunities. Web based portfolio systems fulfill some of the requirements and allow for the acquisition, management and retrieval of the information and knowledge.

Once the portfolio has been captured, how can the information and knowledge contained within be extended and updated? This paper describes a framework that can be used to enhance a portfolio that allows both the owner and users to add annotations both in and out of context. A prototype system is described that has been developed to demonstrate the feasibility of such a framework.



### **F.3.5      Working with multimedia in an online environment.**

Verhaart, M. (2006) Working with multimedia in an online environment, *Distance Education Association of New Zealand (DEANZ) 2006 Conference*. July 3-5, 2006 Auckland, New Zealand

#### **ABSTRACT**

The use of web technologies to deliver content gives the ability to provide a rich multimedia learning experience. However, there are many considerations that need to be taken into account to effectively utilize multimedia. The paper examines the use of multimedia in web based learning environments and discusses some related issues. An innovative online prototype delivery model that is being trialed is used to describe some of these issues. Further, this paper will provide some practical suggestions that will be of use to course designers when including online multimedia content.

### **F.3.6            Issues surrounding course content migration: Blackboard to Moodle**

Jamieson, J. & Verhaart, M. (2005) Issues surrounding course content migration: Blackboard to Moodle. In S. Mann, T. Clear (Eds.) *Proceedings of the 18<sup>th</sup> Annual Conference of the National Advisory Committee on Computing Qualifications Conference*, Tauranga, New Zealand. July 10-13. pp. 197-200.

#### **ABSTRACT**

Cost benefits and a maturing of Open Source technology is driving a move within educational organisations to consider shifting their Managed Learning Environments from commercially available systems. This will have a significant impact on the staff both in terms of time to convert and time to learn the new system. For those who use the features of the existing system, the ability to import existing material easily into the new environment could have a significant effect in the successful implementation of the change.

This paper looks at the transition from Blackboard to Moodle through the use of three case studies.

### **F.3.7 Adding semantics and context to media resources to enable efficient construction of Learning Objects.**

Verhaart M. & Kinshuk (2004). Adding semantics and context to media resources to enable efficient construction of Learning Objects. In Kinshuk, Looi C.-K., Sutinen E., Sampson D., Aedo I., Uden L. & Kähkönen E. (Eds.) *Proceedings of the 4th IEEE International Conference on Advanced learning Technologies 2004*, (August 30 - September 1, 2004, Joensuu, Finland) Los Alamitos, CA: IEEE Computer Society, 651-653. } ISBN 0-7695-2181-9

#### **Citations**

- Del Moral, M<sup>a</sup>. E. & Cernea, D. A. (2005) Design and Evaluate Learning Objects in the New Framework of the Semantic Web. Retrieved June 15, 2006 from <http://www.formatex.org/micte2005/357.pdf>
- Mimirinis, M. & Dafoulas, G.A. Enriching a Pedagogical Model for the Implementation of a Virtual Training Environment. Fifth IEEE International Conference on Advanced Learning Technologies (ICALT'05) pp. 419-420 (DOI Bookmark: <http://doi.ieeecomputersociety.org/10.1109/ICALT.2005.141>) Retrieved June 15, 2006 from <http://csdl.computer.org/comp/proceedings/icalt/2005/2338/00/23380419.pdf>
- Rossano, V., Joy, M., Roselli, T., & Sutinen, E. (2005) A Taxonomy for Definitions and Applications of LOs: A Meta-analysis of ICALT papers. *Educational Technology & Society*, 8 (4), 148-160

#### **ABSTRACT**

No matter which pedagogical method of delivery is selected by an instructor, there is a need to develop appropriate content for the learner. The content may be original, published or a combination of both. Published material may take many forms, and one form that is rapidly growing in popularity is that of a sharable learning object. Many repositories are being built where learning objects are stored for sharable access, and meta-data is added to give each learning object a context.

Crafting a course of study may require a combination of sharable and personal learning objects. In many instances an instructor/facilitator may only require part of a learning object, such as an image, rather than the entire learning object.

This paper describes a meta-data model that would standardize the description of a media resource, by tagging the resource with derived and annotated metadata. Further, this would allow the resources to be given a context for efficient inclusion into a course.

### **F.3.8            Learning Object Repositories: How useful are they?**

Verhaart, M. (2004) Learning Object Repositories: How useful are they? In S. Mann, T. Clear (Eds.) *Proceedings of the 17<sup>th</sup> Annual Conference of the National Advisory Committee on Computing Qualifications Conference*, Christchurch, New Zealand., July 6-9.465-469. NACCQ, Hamilton, NZ.

#### **ABSTRACT**

The packaging and distribution of learning content into learning objects is increasingly being discussed as a natural evolution into allowing for greater distribution of learning materials and cutting the costs of producing and delivering content.

There is a view that the learning object will allow both educators and learners to individualise their material to best align with their teaching and learning styles, though customization raises some interesting issues.

Many groups and organisations are collecting learning objects in electronic repositories, enabling their sharing across the world. Products such as Blackboard allow learning objects to be integrated within the learning management system.

This paper looks at what learning objects are, the terminology and standards that surround them, and issues relevant to their collection, use and maintenance. The primary focus will be to review some existing learning object repositories, and discuss their usefulness in relation to providing course content.

### **F.3.9 Collecting, organizing and managing non-contextualised data, by using MVML to develop a Human-Computer Interface**

Verhaart, M., Jamieson, J. & Kinshuk (2004) Collecting, organizing and managing non-contextualised data, by using MVML to develop a Human-Computer Interface, *Computer Human Interaction, 6th Asia Pacific Conference, APCHI 2004*, Rotorua, New Zealand, June/July 2004.

#### **ABSTRACT**

One aspect of information technology increasingly being researched is organizing and managing the huge repository of data and information available. This is particularly relevant in the context of the explosion in Internet use. As knowledge is gathered from the Internet the ability to retain and recall the knowledge is becoming more and more difficult and complex. Computer based techniques are often used to store and manage this data. Managing the data typically takes two forms; firstly cross-referencing to the original source as in a bibliography or reference list, or secondly collected by an individual, such as purchasing a book, creating a hard copy of a web page, and so forth. With the Internet, web based tools and techniques are frequently employed to manage this information. This may be by maintaining a list of links as in a portal to actual web content, by using the available web search engines, or saving the content into a personal electronic knowledge space.

This paper will look at the ways this knowledge could be collected and the smallest unit required to organize small pieces of data. The ability to map this into an electronic medium is then explored, and a prototype meta-data schema is then discussed. Finally, the Human-Computer Interface will be discussed that could enable the data to be organized in a variety of ways based on the meta-data schema.

### **F.3.10      Creating a virtual face-to-face delivery environment.**

Verhaart, M. & Kinshuk (2004) Creating a virtual face-to-face delivery environment. *Third Pan-Commonwealth Forum on Open Learning*, Dunedin, New Zealand, 4 - 8 July 2004 ( <http://www.col.org/pcf3> )

#### **ABSTRACT**

One particular challenge that educators face in a technologically maturing environment is the use of the technology to assist in delivering material in a way that maintains the benefits of face-to face (f2f) teaching while leveraging the advantages of the electronic delivery media. The ability to create an interactive experience encompassing not only the delivery but also the interaction is possible using web based technologies.

The paper discusses the advantages of face to face and on-line delivery systems and then discusses an innovative on-line prototype delivery model.

### **F.3.11 Knowledge Capture at Source. Developing collaborative shared resources.**

Verhaart, M. (2002, Dec) Knowledge Capture at Source. Developing collaborative shared resources. Doctoral Student Consortium Papers. *Proceedings International Conference on Computers in Education*, (December 3-6, 2002, Auckland, New Zealand), Los Alamitos, CA: IEEE Computer Society, 1484-1485 (ISBN 0-7695-1509-6).

#### **ABSTRACT**

Today's organisations have well developed systems for capturing financial data and producing reliable and accurate information. An area that is often overlooked is the importance of knowledge held by individuals associated with the organisation. This is also true in an educational setting, where learners can often contribute real-world and personal experiences.

The difficulty of capturing this knowledge provides many challenges, in both business and educational settings. In order to be of any use, this knowledge has to be captured at its source and easily disseminated among those who will be interested or affected by this knowledge. The World Wide Web may be a potential technology platform.

The research in progress looks at whether this data/information can be effectively and efficiently captured, managed and retrieved, in an educational context. It will further look at whether generalisations can be made across different domains, including Business and Government.

### **F.3.12      Migrating to a New Technology: Up-Skilling to Web Databases**

Verhaart, M and Jamieson, J. (2002, July) Migrating to a New Technology: Up-Skilling to Web Databases. , In Mann, S. (ed), *Proceedings of the 15th Annual Conference of the National Advisory Committee on Computing Qualifications*, 2nd - 5th July 2002 Hamilton, New Zealand, pp 423-426 ISBN 0-473-08747-2

#### **ABSTRACT**

As an educator in information technology a constant challenge is to keep up-to-date with current trends. In some instances this can be trivial, in others it requires a significant investment in time and research.

One trend that has emerged is the shift from static html web pages to interactive pages, in particular the shift to database driven web pages.

This paper looks at how an existing stand-alone database has been transferred to the web. It investigates what technology needs to be considered, and the depth of knowledge required to create and maintain such a system.

The paper is written from the perspective of a lecturer coming to grips with the new technology rather than creating a set of course notes suitable for teaching this subject.

In this scenario a database is transferred from one simple technology in this case MS-Access on MS-Windows, to a web technology where there are many interrelated factors that need to be considered. These include additional web based considerations, such as the ability to access material globally via open networks and to enable collaborative updating.



## **F.4 Technical Report**

### **F.4.1 A web based assistance system to capture annotations in context and acquire knowledge at source.**

Verhaart, M. & Kinshuk (2005). A web based assistance system to capture annotations in context and acquire knowledge at source. *Perspectives of Intelligent Systems' Assistance (PISA)*. Massey University, 3-5 March 2005, Palmerston North, New Zealand. ( Massey University (2005/02) PISA Workshop 2005. Retrieved April 4, 2005 from [http://infosys.massey.ac.nz/research/rs\\_techreports.html](http://infosys.massey.ac.nz/research/rs_techreports.html) )

#### **ABSTRACT**

As an educator, one important task is to organize personal knowledge and reproduce it in such a way that this knowledge can be disseminated amongst students. Web technologies provide an opportunity to develop systems that through their availability and accessibility can become virtual assistants. For the lecturer, an opportunity to create a repository of personal information to assist in the collection, management and dissemination of their knowledge, for students the ability to access the lecturer's personal portfolio and seek assistance, and for visitors (those who access the portfolio but are not likely to have met the lecturer) the ability to interact with the virtual knowledge of the lecturer.

Personal knowledge is continually increasing, through research, experience and from contact with other individuals and the necessity to keep it current. In the past the research was primarily from the print media while personal contact was from a reasonably small number of people including teachers, social contacts and peer group.

With its ubiquitous nature the internet provides continuous accessibility to a vast amount of information. Contacts can include many people, colleagues, students that are known personally as well as those through the web who an individual has never met face to face, but correspondence may be occurring at very frequent intervals. Research that in the past would have taken months can now be done much more quickly from a computer connected to the World Wide Web.

There have been many terms that have become associated with the internet's size, such as,; "islands of data", "lost in hyperspace", "drowning in a sea of data" and more recently to "Googlise". Many point to the sheer volume of information and the web has been

described as "a huge library where all the books are strewn on the floor".

Hence, organizing knowledge in domain repositories provide vast amounts of information, but very little in the way of assistance to the visitor or researcher. Research via a search engine will often produce content that is delivered out of context. For example, an image from one site may be used to illustrate a different context in another. Other common web technologies, such as email can contain requests for assistance and refer to specific content, but manual alignment is necessary in order to match the content and context.

If knowledge is "what we know", and the amount of knowledge we can acquire is increasing dramatically, it becomes important that there is an efficient way to acquire, manage, organize and disseminate it. Using web technologies a personal knowledge portfolio can be created and be accessible to a wide audience.

This paper discusses an annotation framework for a web based assistant system that can be used assist in the collection and management of an individual's knowledge and allows for peer-to-peer knowledge collection and dissemination.

## **F.4.2      Meta data schema for divergent data types to be captured at the source**

Verhaart, M. (2003, August), Meta data schema for divergent data types to be captured at the source, *Technical Report 6/2003*, Department of Information Systems, Massey University, ISSN 1175-1738. Presented at PhD Workshop June 10, 2003.

### **ABSTRACT**

Today's organisations have well developed systems for capturing financial data and producing reliable and accurate information. An area that is often overlooked is the importance of knowledge held by individuals. This is also true in an educational setting, where learners can often contribute real-world and personal experiences.

The difficulty of capturing this knowledge provides many challenges, in both business and educational settings. In order to be of any use, this knowledge has to be captured at its source and easily disseminated among those who will be interested or affected by this knowledge. The World Wide Web is a potential technology platform.

The research in progress looks at whether this data/information can be effectively and efficiently captured managed and retrieved, in an educational context.

Knowledge can be described in a variety of multimedia formats. Typically we deal with this in a textual format, but there are a wide variety of ways in which this knowledge may be conveyed. This paper discusses some initial research and development where the author has been building a model and constructing a framework to explore a meta-data schema for multiple data types to be captured at source. The system is work in progress, and can be viewed at <http://www25.brinkster.com/verhaart/>

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