

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

**TEACHER PROFESSIONAL LEARNING FOR  
TECHNOLOGY INTEGRATION IN MATHEMATICS  
CLASSROOMS THROUGH ONLINE LEARNING  
COMMUNITIES**

**A thesis presented in partial fulfilment of the  
requirements for the degree of  
Doctor of Philosophy in Information Technology  
at Massey University, Albany  
New Zealand**

**Zaenal Abidin  
2018**

This page is intentionally left blank

## ABSTRACT

The new school curricula in Indonesia emphasise the integration of technology into instructional practices. The infusion of technology in mathematics education requires teachers to align their teaching practices with ongoing technological innovations. Integrating technology into mathematics classrooms requires teachers to have a good knowledge of mathematics content, technology and pedagogy. Teachers also need to consider their school environments. Existing teacher professional development programmes are seen to be failing to meet teacher needs regarding content delivery that sometimes does not match the existing school conditions.

The premise underlying this research is that the use of an online learning community (OLC) may present a possible solution to the current challenges. Thus, the intention of this study was to investigate the potential of OLCs to help develop teachers' learning to fulfil their professional needs in integrating technology with the teaching of mathematics.

An ethnographic approach was used to investigate the phenomenon of teacher learning within an OLC and the implementation of the new knowledge acquired in their mathematics teaching practices. Empirical data from five case studies were used to examine how participation in the OLC affected teaching practices for five teachers. The results revealed that teacher participation in an OLC offered opportunities and challenges. Teachers de-privatized their practices as they actively engaged in social learning interactions to share knowledge and help each other with the appropriate use of technology in teaching mathematics. Teachers also faced some challenges, which impeded them. These challenges included differences in school policies, such as restrictions on using social media and limited technical infrastructure, which hindered teachers from fully leveraging the OLC. Teachers with less experience in teaching with technology and with low levels of technology skills tended to be passive in the OLC. Cultural contexts revealed that lack of experience and caution about expressing opinions made teachers feel *ewuh pakewuh*, a shyness in openly expressing their thoughts. Despite these barriers, the study provided evidence that teachers improvised and dealt with situations as they rose.

The findings of this study provided evidence that participation in the OLC had significant impacts on teachers' professional learning. Teachers altered their mode of using technology either as a partner or as an extension of self as they gained more confidence in their own learning. The teachers gradually transformed their participation from peripheral to full participation in promoting the use of technology for teaching mathematics. The research provides new insights into ways teachers can be helped to develop their professional learning in the use of technology for teaching mathematics through participation in OLCs. Particularly for Indonesia, the findings of this research provide an OLC-based model that could be implemented in other contexts that share similar technology landscapes and sociocultural heritages.

## ACKNOWLEDGEMENTS

My PhD journey has been amazing in many different ways, and would not have been possible without the exceptional people around me, whom I would like to thank.

All praises to Allah SWT, the Almighty God. I have been blessed by His mercy and His grace to undertake my doctoral study in New Zealand. I am thankful for His guidance and for the strength He has granted me to accomplish this PhD journey.

My sincere gratitude goes to my supervisors Dr. Anuradha Mathrani and Professor Roberta Hunter. I am truly thankful for their support, guidance, patience, dedication and encouragement in working with me on this PhD journey and the meticulous process of writing. I would also like to thank Dr. David Parsons and Dr. Suriadi, who supervised me during the first year of my PhD; they always inspired and encouraged me by providing honest and constructive feedback.

I would like to thank all the teachers who so willingly allowed me to enter their world and journey with them as they transformed their teaching practices with technology. Their willing participation in the online learning community, their ability to openly grapple with change and continue with the journey, and the excitement they expressed as their journey progressed were a source of strength, which sustained my own journey.

I wish to thank the Project Management Unit of Universitas Negeri Semarang, which provided an Islamic Development Bank scholarship for my doctoral study. I would also like to thank the Indonesia Endowment Fund for Education (LPDP) of the Ministry of Finance of the Republic of Indonesia for granting me a dissertation scholarship and Massey University for the doctoral completion award for the completion of this thesis.

A special tribute and thanks to my parents, who never had the chance to attend formal schooling, but always hoped, encouraged and trusted that one day I would

be the one they were dreaming of. Thanks also to my beloved wife, Indri Puspitaningtyas, who has always supported me to live my dream and complete this PhD to the highest level; without her support, this long distance relationship would have been more stressful and difficult to cope with. My lovely and precious children, Nafeeza Zaina Azkadina Mecca, Zealand Zayeda Zain, and Liam Kenzo Zain; I offer the hope that this will inspire and motivate you to face your future endeavours. I am so sorry for not being able to give you as much attention as I would have liked during my PhD study. I do hope we can enjoy more things together in the forthcoming period. I will also be forever grateful to my in-laws and other family members for their endless prayers and support during my study in New Zealand.

I am also grateful that I have been surrounded by supportive and helpful people: Joshua, Sibghat, Baryalai, Rahila, Jumbo, Jun, Azadeh, and Hakim. Stay in touch!

## TABLE OF CONTENTS

ABSTRACT.....	i
ACKNOWLEDGEMENTS .....	ii
TABLE OF CONTENTS.....	iv
LIST OF TABLES .....	x
LIST OF FIGURES .....	xi
LIST OF ACRONYMS AND ABBREVIATIONS AND DEFINITIONS .....	xiii
CHAPTER ONE: INTRODUCTION.....	1
1.1 Introduction .....	1
1.2 Background to the Study .....	4
1.2.1 Teacher professional development in Indonesia .....	5
1.2.2 Technology integration in schools.....	9
1.3 Research Questions .....	11
1.4 Rationale for the Study.....	12
1.5 Contribution of the Thesis.....	14
1.6 Roadmap of the Study .....	17
1.7 Overview of the Thesis.....	19
CHAPTER TWO: LITERATURE REVIEW.....	21
2.1 Introduction .....	21
2.2 Teacher Learning and Teacher Professional Development.....	22
2.2.1 Teachers change as they embrace technology .....	24
2.2.1.1 <i>Attitude</i> .....	27
2.2.1.2 <i>Knowledge</i> .....	28
2.2.1.3 <i>Self-efficacy</i> .....	29
2.2.1.4 <i>Pedagogical beliefs</i> .....	30
2.2.1.5 <i>Culture</i> .....	32
2.2.2 Effective teacher professional development.....	33
2.3 Professional Learning Community.....	35
2.4 Online Learning Community.....	37
2.4.1 Community (Community of practice) .....	39
2.4.2 Learning (Collaborative learning) .....	42

2.4.3	Network (Social presence).....	43
2.4.4	Technology (Knowledge construction) .....	45
2.4.4.1	<i>Facebook and Facebook Messenger</i> .....	45
2.4.4.2	<i>WhatsApp</i> .....	47
2.5	Sociocultural Learning Theories .....	48
2.5.1	Valsiner’s zone theory .....	50
2.5.2	Using zone theory in teacher professional learning.....	52
2.6	Summary .....	56
<b>CHAPTER THREE: METHODOLOGY .....</b>		<b>59</b>
3.1	Introduction .....	59
3.2	Research Questions .....	60
3.3	Researcher’s Role.....	61
3.4	An Ethnographic Case Study Approach.....	63
3.4.1	Ethnographic methodology.....	63
3.4.2	Case study methodology.....	64
3.5	Research Design .....	66
3.5.1	Study Propositions .....	67
3.5.2	Units of analysis .....	67
3.5.3	Determination of how the data were linked to the propositions.....	68
3.5.4	Criteria for interpreting the findings.....	70
3.5.5	A conceptual framework of online learning community for teacher professional learning.....	71
3.6	Ethical Considerations.....	73
3.6.1	Informed consent .....	74
3.6.2	Anonymity and confidentiality .....	75
3.7	Participants .....	76
3.7.1	The preliminary study participants .....	77
3.7.2	The case study participants.....	78
3.8	Data Collection.....	79
3.8.1	Data collection in the preliminary study.....	80
3.8.2	Data collection in the main study .....	81
3.8.2.1	<i>Participant observation</i> .....	81
3.8.2.2	<i>Interviews with teachers</i> .....	82



3.8.2.3	<i>Open-ended survey questions</i> .....	83
3.8.2.4	<i>Documents and online posts</i> .....	84
3.8.2.5	<i>Exit from the field</i> .....	84
3.9	Data Analysis .....	85
3.9.1	Data analysis of the preliminary study .....	85
3.9.2	Data analysis of the main study .....	86
3.10	Data Presentation.....	90
3.11	Trustworthiness and Validity .....	91
3.11.1	Interpretive validity .....	92
3.11.2	Internal validity.....	93
3.11.3	External validity .....	93
3.12	Summary .....	94
CHAPTER FOUR: POTENTIALS AND CHALLENGES OF MOBILE TECHNOLOGY INTEGRATION IN THE MATHEMATICS CLASSROOM: A PRELIMINARY STUDY .....		97
4.1	Introduction .....	97
4.2	Background to the Study .....	97
4.3	Research Method Employed for the Preliminary study .....	100
4.4	Empirical Findings from the Preliminary study .....	101
4.4.1	Leveraging mobile technology affordances .....	101
4.4.2	Challenges in using mobile devices for mathematics instruction... 104	
4.5	Discussion and Recommendations .....	108
4.5.1	Teachers' personal use of mobile devices .....	108
4.5.2	Ethical considerations in mobile device use.....	109
4.6	Implications for the Main Study.....	111
4.7	Summary .....	113
CHAPTER FIVE: SOCIAL LEARNING INTERACTIONS IN AN ONLINE LEARNING COMMUNITY .....		115
5.1	Introduction .....	115
5.2	Participation in the OLC.....	116
5.2.1	Participation in the closed Facebook group.....	116
5.2.2	Participation in the Facebook Messenger group and the WhatsApp group.....	118

5.3	Learning Interactions in the OLC.....	121
5.3.1	Learning interactions in the OLC-FB.....	121
5.3.1.1	<i>Example of teacher’s entry on the OLC-FB.....</i>	123
5.3.1.2	<i>Example of researcher’s entry on the OLC-FB.....</i>	125
5.3.2	Learning interactions in the OLC-IM.....	127
5.3.2.1	<i>Example of social interactions in the WA Group .....</i>	129
5.3.2.2	<i>Example of social interactions in the FB Messenger group .....</i>	131
5.4	Social Interaction Patterns.....	133
5.4.1	Interaction patterns in the OLC-FB.....	134
5.4.2	Interaction patterns in the OLC-IM.....	137
5.5	Views from the Five Teachers on Their Participation in the OLC .....	140
5.5.1	Sustained examination of practice.....	140
5.5.2	De-privatization of practice .....	142
5.5.3	Problem solving.....	144
5.6	Sustainability of Social Learning Interactions in the OLC .....	144
5.7	Summary .....	147
<b>CHAPTER SIX: TEACHING PRACTICES WITH TECHNOLOGY: WHAT THE FIVE TEACHERS LEARNT FROM THE OLC .....</b>		<b>149</b>
6.1	Introduction .....	149
6.2	Introducing the Five Teachers.....	150
6.2.1	School context .....	150
6.2.2	Availability of and accessibility to technology facilities.....	151
6.2.3	Teachers’ technology experiences and skills.....	153
6.3	From a Technology Workshop to a Technological Tools Tryout in the Mathematics Classroom .....	154
6.3.1	Selection of appropriate technological tools .....	155
6.3.2	Identification of teaching strategies.....	157
6.3.3	Dealing with the issues.....	159
6.4	Classroom Teaching Practices with Technology .....	162
6.4.1	Nana: Using familiar technological tools to support student learning.....	163
6.4.2	Setyo: An animated video and a game-based assessment .....	165

6.4.3	Joko: Mathematics practices with technological tools for national exam preparation .....	169
6.4.4	Udin: Learning from video tutorials and creating presentation videos with technological tools .....	171
6.4.5	Edi: Outdoor classroom activities with technological tools .....	174
6.5	Post Classroom Observations .....	177
6.5.1	Nana's story .....	178
6.5.2	Setyo's story .....	179
6.5.3	Joko's story .....	181
6.5.4	Udin's story .....	182
6.5.5	Edi's story .....	182
6.6	Five Teachers' Evolving ZFM/ZPA/ZPD Systems .....	183
6.6.1	Nana's case .....	183
6.6.2	Setyo's case .....	186
6.6.3	Joko's case .....	189
6.6.4	Udin's case .....	191
6.6.5	Edi's case .....	193
6.7	Summary .....	195
<b>CHAPTER SEVEN: DISCUSSION</b> .....		199
7.1	Introduction .....	199
7.2	Facilitators and Barriers Related to Participating in the OLC .....	200
7.3	Activities in the OLC that Promoted Teachers' Professional Learning .....	209
7.4	Development of Teacher Professional Learning Through Participation in the OLC .....	215
7.5	Summary .....	223
<b>CHAPTER EIGHT: CONCLUSIONS AND IMPLICATIONS</b> .....		225
8.1	Introduction .....	225
8.2	Key Findings .....	227
8.3	Contributions .....	235
8.4	Limitations .....	239
8.5	Implications and Further Research .....	241
8.6	Concluding Words .....	243
<b>REFERENCES</b> .....		245

APPENDICES .....	273
APPENDIX A: Full Ethics Approval Letter .....	273
APPENDIX B: Low Risk Notification of Preliminary study .....	274
APPENDIX C: Teacher Information Sheet and Consent Form .....	275
APPENDIX D: Information Sheet for Parents/Guardians, and Consent Form for Parents/Guardians and Assent Form for Students .....	279
APPENDIX E: Survey Questions of the Preliminary Study .....	284
APPENDIX F: Open-Ended Survey Questions of the Main Study.....	288
APPENDIX G: List of Categories of Data .....	289
APPENDIX H: Data Management and Analysis with NVivo .....	292
APPENDIX I: Gephi Graph Visualization and Manipulation Software .....	294
APPENDIX J: The Closed-Facebook Group, the Facebook Messenger Group, and the WhatsApp Group .....	295
APPENDIX K: Photographs from One-Day Technology Workshop from the Preliminary study, Technology Workshop and Mathematics Classroom Teaching Practices with Technology from the Main Study .....	298
APPENDIX L: List of Publications and Presentations .....	300

## LIST OF TABLES

Table 2.1	Factors affecting teachers' use of technology (Goos, 2013, p. 524) ..	55
Table 3.1	Elements of the conceptual framework .....	70
Table 3.2	Demographic information of the schools .....	78
Table 3.3	Demographic information of the five teachers .....	79
Table 3.4	Timeline of data collection .....	80
Table 4.1	Teachers' activities in the use of mobile devices .....	103
Table 5.1	Social network parameters for interactions in the OLC-FB .....	136
Table 5.2	Social network parameters for interactions in the OLC-IM .....	139
Table 5.3	Total posts, comments, and reactions on the OLC-FB in the period from September 2016 to May 2017 .....	145
Table 7.1	The tasks of a mediator and social host in the OLC .....	213
Table 7.2	Factors affecting teacher participation in the OLC .....	221

## LIST OF FIGURES

Figure 1.1	Roadmap of study .....	18
Figure 2.1	The theoretical framework for online learning community (Tu & Corry, 2002, p. 6) .....	39
Figure 3.1	Determining how the data are linked to the propositions .....	68
Figure 3.2	Conceptual framework for an online learning community for teacher professional learning (adapted from Tu & Corry, 2002; Valsiner, 1997) .....	72
Figure 5.1	Social interactions among members of the OLC-FB (March–August 2016) .....	121
Figure 5.2	Edi’s entry on the OLC-FB .....	123
Figure 5.3	Researcher’s entry on the OLC-FB .....	125
Figure 5.4	Social interactions among members of the OLC-IM (March-August 2016) .....	128
Figure 5.5	Online discussion in the WA group .....	129
Figure 5.6	Online discussion in the FB Messenger group .....	132
Figure 5.7	Interaction patterns of OLC-FB’s members .....	135
Figure 5.8	Interaction patterns of members in the FB Messenger group .....	137
Figure 5.9	Interaction patterns of members in the WA group .....	138
Figure 5.10	Social interactions between members of the WA group in the period from September 2016 to May 2017 .....	146
Figure 6.1	Relationships between Nana’s ZFM, ZPA, and ZPD at the beginning of the current study .....	185
Figure 6.2	Relationships between Nana’s ZFM, ZPA, and ZPD as the current study progressed .....	186
Figure 6.3	Relationships between Setyo’s ZFM, ZPA, and ZPD at the beginning of the current study .....	187
Figure 6.4	Relationships between Setyo’s ZFM, ZPA, and ZPD as the current study progressed .....	188
Figure 6.5	Relationships between Joko’s ZFM, ZPA, and ZPD at the beginning of the current study .....	190

Figure 6.6	Relationships between Joko's ZFM, ZPA, and ZPD as the current study progressed .....	191
Figure 6.7	Relationships between Udin's ZFM, ZPA, and ZPD at the beginning of the current study .....	192
Figure 6.8	Relationships between Udin's ZFM, ZPA, and ZPD as the current study progressed .....	193
Figure 6.9	Relationships between Edi's ZFM, ZPA, and ZPD at the beginning of the current study .....	194
Figure 6.10	Relationships between Udin's ZFM, ZPA, and ZPD as the current study progressed .....	195

## LIST OF ACRONYMS AND ABBREVIATIONS AND DEFINITIONS

3D	Three-dimensional. In the context of geometry, 3D objects are objects with three dimensions (height, width and depth)
CONINCON	Connection, Integration and Contextual, a learning model
CoP	Community of Practice
CK	Content Knowledge
F2F-ZPA	Face-to-Face – Zone of Promoted Actions
FB	Facebook
FBMG	Facebook Messenger Group
GPS	Global Positioning System
ICT	Information and Communication Technology
JPNN	Jawa Pos News Network. Jawa Pos is an Indonesian national daily newspaper, and JPNN is Jawa Pos' newspaper networks.
JSIT	<i>Jaringan Sekolah Islam Terpadu</i> (Integrated Islamic Schools Network)
K-13	<i>Kurikulum</i> 2013 (the 2013 Curriculum)
KTSP	<i>Kurikulum Tingkat Satuan Pendidikan</i> (School-Based Curriculum)
LCD	Liquid Crystal Display
LPMP	<i>Lembaga Penjamin Mutu Pendidikan</i> (Institute for Educational Quality Assurance)
NCTM	National Council of Teachers of Mathematics
OECD	Organisation for Economic Co-operation and Development
OLC	Online Learning Community
OLC-FB	Online Learning Community – Facebook
OLC-IM	Online Learning Community – Instant Messenger
OLC-ZPA	Online Learning Community – Zone of Promoted Actions
PAKEM	<i>Pembelajaran Aktif, Kreatif, Efektif, dan Menyenangkan</i> (Active, Creative, Effective, and Joyful Learning)
PCK	Pedagogical Content Knowledge
PLC	Professional Learning Community
PK	Pedagogical Knowledge



PKB	<i>Pengembangan Keprofesian Berkelanjutan</i> (sustainable professional development)
PMRI	<i>Pendidikan Matematika Realistik Indonesia</i> (Indonesian Realistic Mathematics Education)
PPPG	<i>Pusat Pengembangan Penataran Guru</i> (Teacher Upgrading Centre for Mathematics)
PPPPTK	<i>Pusat Pengembangan dan Pemberdayaan Pendidik dan Tenaga Kependidikan</i> (Centre for the Development and Empowerment of Educators and Educational Personnel)
SNS	Social Networking Site
ToT	Training of Trainer
TPACK	Technological Pedagogical Content Knowledge
TPD	Teacher Professional Development
UNBK	<i>Ujian Nasional Berbasis Komputer</i> (computer-based national examination)
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-UIS	UNESCO Institute for Statistics
UKG	<i>Ujian Kompetensi Guru</i> (Examination of Teachers' Competency)
WA	WhatsApp
WAG	WhatsApp Group
Wi-Fi	A technology for wireless local area network with devices based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards. It is a trademark of the Wi-Fi Alliance, a non-profit organization that promotes Wi-Fi technology and certifies Wi-Fi products if they conform to certain standards of interoperability.
ZFM	Zone of Free Movement
ZPA	Zone of Promoted Action
ZPD	Zone of Proximal Development