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The Development and Sustainment of Small Online Learning Communities of Teachers

Michael James Moroney

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy, The University of Auckland, 2013
Abstract

The aim of this study is to make a contribution to knowledge of how an online collaborative professional learning community (OLC) might be created, supported, developed, and sustained. Although the literature of collaborative professional learning and practice supports the notion that teachers learn better when they talk to each other, there is a paucity of research to explain how teachers might learn collaboratively online.

Analysis of web tracking statistics and content analysis techniques were used to examine data from web server logs when 60 Brunei teachers participated in a nine-month online, collaborative, professional learning community development programme. The Cultural-Historical Theory of Activity model was used as a tool for analysing online, collaborative, professional learning community performance.

Findings show that online, collaborative, professional learning communities are not satisfactorily explained by theories about offline, collaborative, professional learning, thereby supporting the notion of the need for an emergent theory of online, collaborative, professional learning communities. A new online, collaborative, professional learning community model has been created to explain the iterative development and complex functioning of such a community. The findings showed that successful communities aspire to achieve dual learning outcomes; they must develop a capacity to learn together in an online setting, while at the same time, seek to achieve practice-related goals.

Policy and practice implications include the need for extensive, individualized pre-training for teachers before they participate in online, collaborative, professional learning, the necessity of dual professional learning tracks, and the identification of 22 characteristics of effective online learning communities that are each vital for the creation, development, and sustainment of online professional learning communities. Several tools for community evaluation and explanation have been developed.
Acknowledgements

I would like to express my heartfelt thanks to my supervisors, Mavis Haigh and John Hope. Their insightful guidance, unswerving support, and ability to get the best out of me have made my personal journey richly rewarding. John's timely reminders of the importance of the big picture issues and Mavis’ eye for detail made them a perfect supervisor combination.

My longstanding colleague David Boorer has been a good critic and friend during this research study, and I could have wished for none better. I am also thankful for the moral support of David Brown, which helped me to stay grounded and remain task-oriented and focussed.

My thanks also go to the hard working Brunei teachers, who provided their time freely, their participation wholeheartedly, and their goodwill and openness throughout this study. Their efforts went far beyond what was necessary, and the results of this study are all the better for that.

I feel most fortunate to know such wonderful, wise people so willing to give of themselves to help me progress in this endeavour.
# Table of Contents

Abstract ...................................................................................................................... ii  
Acknowledgements ................................................................................................. iii  
List of Tables ........................................................................................................... xii  
List of Figures ......................................................................................................... xiv  
Operational Terms ................................................................................................. xiv  

Chapter 1. Introduction ............................................................................................ 2  
1.1. Origins of this Thesis ..................................................................................... 2  
1.2. About the Researcher ...................................................................................... 6  
1.3. The Brunei Professional Learning Ecosystem .............................................. 6  
1.4. Significance of the Study .............................................................................. 8  
1.5. Practical Challenges of the Study .................................................................. 9  
1.6. A Dual Track Professional Development Pipeline ....................................... 9  
1.7. Collaborative Professional Learning Theory ................................................. 14  
1.8. Professional Learning Communities ............................................................. 14  
1.9. Communities of Practice .............................................................................. 15  
1.10. Cultural-Historical Theory of Activity Framework ...................................... 15  
1.11. Web Tracking Statistics ............................................................................... 15  
1.12. Research Questions ..................................................................................... 16  
1.12.1. Research Question One ......................................................................... 16  
1.12.2. Research Question Two ......................................................................... 16  
1.13. Overview of the Methodology for the Study .............................................. 17  
1.14. Organization of this Thesis ......................................................................... 18  
1.15. Summary ..................................................................................................... 19  

Chapter 2. Literature Review .................................................................................. 20  
2.1. Introduction .................................................................................................. 20  
2.2. Learning in a Community ............................................................................. 20  
2.2.1. Characteristics of Effective Learning Communities .................................. 21  
2.2.2. Learning Community Models ................................................................... 24
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2.1. Demographic Information</td>
<td>87</td>
</tr>
<tr>
<td>5.2.2. Age and Gender Demographics</td>
<td>87</td>
</tr>
<tr>
<td>5.2.3. Access to a Laptop</td>
<td>88</td>
</tr>
<tr>
<td>5.2.4. Access to the Internet</td>
<td>88</td>
</tr>
<tr>
<td>5.2.5. Likert Scale Item Analysis</td>
<td>90</td>
</tr>
<tr>
<td>5.2.6. Open-ended Question Responses</td>
<td>94</td>
</tr>
<tr>
<td>5.2.7. Teacher Use of Online Tools for Professional Learning</td>
<td>95</td>
</tr>
<tr>
<td>5.2.8. Teacher Use of Technologies</td>
<td>96</td>
</tr>
<tr>
<td>5.2.9. Professional Development Strategies and Experiences</td>
<td>97</td>
</tr>
<tr>
<td>5.2.10. Collaborative Learning Experiences</td>
<td>97</td>
</tr>
<tr>
<td>5.2.11. Use of the Internet</td>
<td>101</td>
</tr>
<tr>
<td>5.2.12. Technologies</td>
<td>102</td>
</tr>
<tr>
<td>5.2.13. Collaborative Learning Experiences</td>
<td>107</td>
</tr>
<tr>
<td>5.3. Summary</td>
<td>107</td>
</tr>
<tr>
<td>Chapter 6. Characteristics of High and Underperforming Communities</td>
<td>109</td>
</tr>
<tr>
<td>6.1. Introduction</td>
<td>109</td>
</tr>
<tr>
<td>6.2. Quantitative Analysis of Activity Frequency Distributions</td>
<td>109</td>
</tr>
<tr>
<td>6.3. Research Participants</td>
<td>109</td>
</tr>
<tr>
<td>6.4. Coding of Communities and Teachers</td>
<td>110</td>
</tr>
<tr>
<td>6.5. Analysis of Moodle Activity Frequency</td>
<td>110</td>
</tr>
<tr>
<td>6.6. OLC Teacher Characteristics</td>
<td>120</td>
</tr>
<tr>
<td>6.7. Teacher Predispositions</td>
<td>123</td>
</tr>
<tr>
<td>6.8. Learning Context</td>
<td>126</td>
</tr>
<tr>
<td>6.9. Processes and Procedures</td>
<td>129</td>
</tr>
<tr>
<td>6.9.1. Project Management</td>
<td>130</td>
</tr>
<tr>
<td>6.9.2. Project Discussion Protocols</td>
<td>133</td>
</tr>
<tr>
<td>6.9.3. Management Style</td>
<td>139</td>
</tr>
<tr>
<td>6.10. Teacher Talk</td>
<td>140</td>
</tr>
<tr>
<td>6.10.1. Linguistic Code Switching</td>
<td>140</td>
</tr>
<tr>
<td>6.10.2. Publishing Capstone Reports</td>
<td>143</td>
</tr>
<tr>
<td>6.10.3. Multiple Communication Modes</td>
<td>143</td>
</tr>
<tr>
<td>6.10.4. Choosing Tools Wisely</td>
<td>144</td>
</tr>
<tr>
<td>6.11. Cognitive Overloading</td>
<td>146</td>
</tr>
</tbody>
</table>
6.12. Distributed Cognition ............................................................... 147
6.13. Digital Literacies ................................................................. 148
6.15. Summary ............................................................................... 149

Chapter 7. Case Study Analysis of the MA and LU learning communities ........................................ 153
  7.1. Introduction ........................................................................ 153
  7.2. Selection of MA and LU for Case Study Analysis .................. 153
  7.3. MA Analysis Procedures .......................................................... 155
  7.4. MA Demographics ................................................................. 155
  7.5. MA Moodle Server Log Analysis ............................................ 156
  7.6. Values of MA Teachers ............................................................ 158
    7.6.1. MA Friendships ............................................................... 158
    7.6.2. MA Trusting Relationships .............................................. 160
    7.6.3. MA Teachers Valued Fairness ........................................... 160
  7.7. MA Teacher Predispositions ................................................... 161
  7.8. MA Teacher Workplace Context ............................................. 162
  7.9. MA Processes and Procedures ................................................. 163
  7.10. MA Project Management Activities ......................................... 163
  7.11. MA Use of the Project Completion Guidelines ....................... 164
  7.12. MA Management Style .......................................................... 165
  7.13. MA Teacher Talk ................................................................. 169
    7.13.1. MA use of Linguistic Code Switching ......................... 170
    7.13.2. MA Production of project Reports ................................... 171
    7.13.3. MA Use of Multiple Communication Channels ............... 172
    7.13.4. MA Tool Usage and Consequences ................................... 172
    7.13.5. MA Collective Cognitive Responsibility ......................... 173
    7.13.6. MA Use of New Software Tools ...................................... 174
  7.14. MA Case Study Summary ...................................................... 176
  7.15. Introduction to LU ................................................................. 177
  7.16. LU Demographics and Context ............................................. 178
  7.17. LU Moodle Server Log Analysis ........................................... 179
  7.18. LU Teacher Values ............................................................... 185
  7.19. LU Teacher Predispositions .................................................. 186
7.20. Processes and Procedures Used by LU Teachers ........................................... 187
7.21. Project Management Activities Used by LU Teachers ................................... 188
7.22. LU Adoption and Adaption of Project Completion Guidelines ...................... 188
7.23. LU Management Style .................................................................................... 190
7.24. LU Teacher Talk .............................................................................................. 191
7.25. LU Use of Linguistic Code Switching ............................................................... 191
7.26. Production of project Reports by LU Teachers ................................................. 192
7.27. The Use of Multiple Communication Channels by LU Teachers ................... 193
7.28. Acceptance of Collective Cognitive Responsibility by LU Teachers ............... 194
7.29. LU Case Study Summary .................................................................................. 194
7.30. Learning Load .................................................................................................. 196
7.31. Prerequisite Competencies ............................................................................... 197
7.32. Group Developmental Requirements .............................................................. 197
7.33. Pre-training Learning Load Indicator .............................................................. 197
7.34. Comparison of Demographics ......................................................................... 202
7.35. Comparison of Moodle Participation Levels .................................................... 202
7.36. Comparison of Individual and Community Values .......................................... 203
7.37. Comparison of Predispositions ........................................................................ 204
7.38. Comparison of Procedures and Practices ......................................................... 204
7.39. Comparison of Project Management Characteristics ....................................... 205
7.40. Comparison of Adoption and Adaption of Project Completion Guidelines ...... 205
7.41. Comparison of Management Styles .................................................................. 206
7.42. Comparison of the Use of Tools ....................................................................... 207
7.43. Collective Cognitive Responsibility ................................................................. 207
7.44. Summary ......................................................................................................... 208

Chapter 8. Discussion .............................................................................................. 210
8.1. Introduction ....................................................................................................... 210
8.2. Learning Load ................................................................................................... 211
8.2.1. Mapping Learning Load Tensions onto the AT Framework ......................... 212
8.2.2. Subjects ........................................................................................................ 213
8.3. The Online, Collaborative Professional Learning Community Model ............. 218
8.4. Subjects and Tools ........................................................................................... 221
8.5. Subjects and Object ......................................................................................... 222
Appendix G. Moodle Activities Recorded in Moodle Server Logs.................................285
Appendix H. Factors that Impact on Learning Performance .......................................287
Appendix I. Moodle Activity Level Statistics .............................................................289
Appendix J. JE Discussion Transcript .......................................................................295
Appendix K. Education in Brunei...............................................................................298
Appendix L: Development of the Online Learning Community Development Indicator.....303
List of Tables

Table 1. Teacher learning processes and outcomes .......................................................... 3
Table 2. Expected key findings of the professional development programme ................. 11
Table 3. Project investigation protocol questions .................................................................. 52
Table 4. Professional learning community performance analysis ....................................... 53
Table 5. TPACKBRU subscales ......................................................................................... 61
Table 6. Analysis of pilot study questionnaire responses .................................................... 63
Table 7. Online Learning Community Development Indicator (OLCDI) ............................ 64
Table 8. Individual activity summaries ............................................................................... 83
Table 9. Internet access barriers ....................................................................................... 89
Table 10. TPACK questionnaire subscale statistics ............................................................ 90
Table 11. CK subscale item statistics .................................................................................. 91
Table 12. PK subscale item statistics .................................................................................. 91
Table 13. PCK subscale item statistics .............................................................................. 92
Table 14. TPCK subscale item statistics ............................................................................ 92
Table 15. TPCK subscale item statistics ............................................................................ 93
Table 16. TK subscale item statistics ................................................................................ 93
Table 17. Subscale item statistics ...................................................................................... 94
Table 18. TPK subscale item statistics .............................................................................. 94
Table 19. Top 10 code families by groundedness and density ........................................... 100
Table 20. Online Learning Community codes ................................................................... 110
Table 21. Moodle activity frequencies for MA teachers ..................................................... 111
Table 22. Number of Moodle discussions conducted by learning communities ............ 113
Table 23. Discussion activity summary for all community teachers ................................ 113
Table 24. Overall project discussion posting statistics ....................................................... 117
Table 25. Moodle activity level statistics for LU ............................................................... 122
Table 26. Community characteristics .............................................................................. 128
Table 27. Moodle activity level statistics for JE ............................................................... 131
Table 28. Moodle activity level statistics for LU ............................................................... 131
Table 29. Moodle activity level statistics for MA ............................................................... 132
Table 30. Project management factors ............................................................................. 132
Table 31. Project process and procedural challenges ......................................................... 139
Table 32. Community management style characteristics .................................................. 140
Table 33. Teacher talk success factors .............................................................................. 145
Table 34. Learning Load Factors ...................................................................................... 148
Table 35. MA rankings analysis ......................................................................................... 153
Table 36. LU rankings analysis ......................................................................................... 154
Table 37. MA teacher characteristics ............................................................................... 156
Table 38. Online activity statistics for MA ........................................................................ 156
Table 39. MA Moodle activity rankings ........................................................................... 158
Table 40. LU teacher characteristics ............................................................................... 178
Table 41. LU Moodle activity summaries ......................................................................... 179
Table 42. LU rankings analysis ......................................................................................... 181
Table 43. Pre-training Learning Load Indicator (PLLI) ................................................................. 198
Table 44. PLLI comparison between MA and LU ............................................................................. 199
Table 45. Professional learning capacity development ................................................................. 216
Table 46. Group, individual, and operational characteristics of learning communities .............. 217
Table 47. Support for learning community characteristics .......................................................... 241
Table 48. MA rankings analysis ..................................................................................................... 280
Table 49. SA rankings analysis ..................................................................................................... 280
Table 50. LM rankings analysis ..................................................................................................... 281
Table 51. JE rankings analysis ..................................................................................................... 281
Table 52. LU rankings analysis ..................................................................................................... 282
Table 53. TT rankings analysis ..................................................................................................... 282
Table 54. IC rankings analysis ..................................................................................................... 282
Table 55. PD rankings analysis ..................................................................................................... 283
Table 56. FA rankings analysis ..................................................................................................... 283
Table 57. ME rankings analysis ..................................................................................................... 284
Table 58. Moodle activity level statistics for MA ........................................................................... 289
Table 59. Moodle activity level statistics for SA ............................................................................ 290
Table 60. Moodle activity level statistics for LM ........................................................................... 290
Table 61. Moodle activity level statistics for JE ............................................................................. 291
Table 62. Moodle activity level statistics for LU ............................................................................ 291
Table 63. Moodle activity level statistics for TT ............................................................................. 292
Table 64. Moodle activity level statistics for IC ............................................................................. 292
Table 65. Moodle activity level statistics for PD ............................................................................. 293
Table 66. Moodle activity level statistics for FA ............................................................................. 293
Table 67. Moodle activity level statistics for ME ............................................................................. 294
Table 68. Gender imbalance in Brunei classrooms ......................................................................... 298
Table 69. Online learning community development indicator (OLCDI) .......................................... 303
List of Figures

Figure 1. Model of teaching and learning online (Salmon, 2005) ........................................... 27
Figure 2. The Activity System Triangle ................................................................. 28
Figure 3. Cultural-historical theory of activity framework .............................................. 30
Figure 4. Communities of practice stages of development ........................................ 36
Figure 5. Context of emergence of virtual communities (Henri & Pudelko, 2003) ....... 44
Figure 6. The CHAT framework ............................................................................. 49
Figure 7. Research design ....................................................................................... 58
Figure 8. Annotated CHAT triangle diagram .......................................................... 73
Figure 9. Teacher age distribution ........................................................................... 88
Figure 10. LU-6 TPACKBRU open-ended question responses ................................... 99
Figure 11. Activity frequency distributions for MA teachers ..................................... 112
Figure 12. Box-whisker plot of discussion posting frequency distributions ............. 118
Figure 13. Ishikawa fishbone diagram (produced by the LM community) .............. 145
Figure 14. Discussion posting frequencies of LU teachers ....................................... 180
Figure 15. Shared values of LU teachers ................................................................... 185
Figure 16. Factors influencing learning load .......................................................... 196
Figure 17. Learning load tensions AT diagram ...................................................... 213
Figure 18. Online, learning community stages of development ................................. 215
Figure 19. Radar chart of learning community development ...................................... 217
Figure 20. Online collaborative professional learning model ..................................... 219
Figure 21. Project management tensions ............................................................... 229
Figure 22. Leadership style tensions AT diagram ................................................... 231
Figure 23. Explicit goals and focus tensions ............................................................ 232
Figure 24. Teacher Values AT Diagram .................................................................. 233
Figure 25. Multiliteracies tensions .......................................................................... 235
Figure 26. Data awareness tensions AT diagram .................................................... 236
Figure 27. Learning tensions activity system diagram .............................................. 238
Figure 28. Social (casual) learning tensions ............................................................ 239
Figure 29. Relationships of Respect and Challenge ................................................ 240

Operational Terms

CHAT          Cultural-Historical Theory of Activity
CoP           Community of Practice
MalEngTex     Malay/English/Text
OLC           Online Collaborative Professional Learning Community
OLCDI         Online Learning Community Development Indicator
PD            Professional Development
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>PLC</td>
<td>Professional Learning Community</td>
</tr>
<tr>
<td>PLLI</td>
<td>Pre-training Learning Load Indicator</td>
</tr>
<tr>
<td>Project</td>
<td>Evidence-based Professional Learning Community Project conducted by a learning community</td>
</tr>
<tr>
<td>TDM</td>
<td>Tailored Design Method</td>
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<tr>
<td>TPACK</td>
<td>Technological pedagogical content knowledge</td>
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Chapter 1. Introduction

1.1. Origins of this Thesis

There has been a persistent focus on improving student learning outcomes in schools over the last several decades (Hirsh & Killion, 2007; Timperley, Wilson, Barrer, & Fung, 2007). During this time, the preferred *modus operandi* employed to achieve desired student learning outcomes has been the *Professional Development* (PD) of teachers.

The goals of such professional development are to change teacher’s knowledge, attitudes, skills, aspirations and behaviours in ways that lead to increased student achievement (Hunzicker, 2012). Commonly, professional learning is designed to help teachers to move from being “anxious about their understanding of subject content” to being “confident that they have a sufficient understanding of content”; from being “dispensers of knowledge” to “facilitators of learning”; from being “closed and authoritative” to being “open to dialogue with students”; from learning being “limited to knowledge gains” to include the “development of reasoning and problem solving skills”; from classroom activities that are “contrived and inauthentic” to “authentic problems that are owned by students” (Aikenhead, 2004).

Recent research suggests that successful professional development is collaborative, school-based, active, progressive, and focused on student learning (Foord & Haar, 2008; Timperley, 2008). However, the professional development of teachers does not always lead to the intended professional learning (National Staff Development Council, 2010), and there is evidence to suggest that professional development providers may neither understand nor be able to set the essential conditions for successful collaborative professional learning.

Drawing on selected data from a one-year research project in two case study schools, the evidence suggests that while it is clear that teachers would value further opportunities to engage in CPL [collaborative professional learning], schools would need to radically alter their structures, processes, and priorities to enable it to happen effectively. (Duncombe & Armour, 2004, p. 142).

The report of the research from which the above quotation was drawn showed the professional development providers, in that case, appeared to be unaware of a number of the characteristics of effective collaborative professional learning. This is, in part, because
“even under the best of circumstances, developing a successful professional learning community is difficult work and requires organizational and leadership strategies that are both foundational and ongoing” (Graham, 2007, p. 14). There have even been cases where continuing professional development has been so poorly implemented that it was blamed for a decline in student achievement:

The problem for both teachers and policy makers has been, however, the prevalence of professional development models and practices that have not ultimately been helpful for improving practice. As this BES [best evidence synthesis] reveals, some have intervened in teachers’ work without sufficient understanding of the complexity of professional practice, changing practices in ways that have, in some cases, actually lowered student achievement. (Timperley et al., 2007, p. xxi)

In particular, collaborative professional learning, as a form of professional development, is not always successfully implemented in schools, as “most school communities find there has been little time and less inclination to go beyond contrived congeniality and goal-directed committee work” (Beatty, 2006, p. 75).

Despite the failures, there is evidence to support the concept of school-based collaborative professional learning (Beatty, 2006; Earl & Timperley, 2009b; Foulger & Williams, 2007; Hlapanis & Dimitracopoulou, 2007; Leonard & Leonard, 2003; Linn, Gill, Sherman, Vaughn, & Mixon, 2010; Wright, 2010). Beatty linked professional learning to “…shared reflection and authentic collaboration – in a supportive study group environment – could create changes in teachers’ perceptions of themselves and their work, and catalyse professional growth” (p.73). There appears to be some consensus of opinion about what professional development should look like, and with reference to this, some work has been done to try to identify the types of activities that might promote collaborative professional learning. A more detailed treatment of collaborative professional learning is presented in section 2.2 of the literature review.

Professional learning programmes may be categorized by the types of learning activities they promote within them. To this end, it is it is helpful to define the activities in terms of the three processes described in Table 1:

Table 1. Teacher learning processes and outcomes

<table>
<thead>
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<th>(Iterative) Learning Processes</th>
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3
The learning processes engaged when developing new understandings and skills involve cycles of (one or more of) the following:

<table>
<thead>
<tr>
<th>Process 1</th>
<th>Cueing and retrieving prior knowledge</th>
</tr>
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<tr>
<td>Outcome:</td>
<td>Prior knowledge consolidated and/or examined</td>
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<table>
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<tr>
<th>Process 2</th>
<th>Becoming aware of new information/skills and integrating them into current values and beliefs system</th>
</tr>
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<tbody>
<tr>
<td>Outcome:</td>
<td>New knowledge adopted or adapted</td>
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<table>
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<tr>
<th>Process 3</th>
<th>Creating dissonance with current position (values and beliefs)</th>
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<tr>
<td>Outcome:</td>
<td>Dissonance resolved (accepted/rejected), current values and beliefs system repositioned, reconstructed</td>
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(Timperley et al., 2007, p. 8)

What is not evident in the table above is if any allowance is made for the hugely important conditions under which teachers must learn, and the cultural and historical influences that impact on professional learning. Therefore, the teachers’ processes and outcomes table may not be especially useful (in the Brunei setting) for predicting the likely outcomes of a professional development programme. This is especially the case for online, collaborative, professional learning, the success of which is determined by a large number of factors.

The types of professional development that lead to teachers changing their values and beliefs (and classroom practices) involve Process 2 and Process 3 activities. An Evidence-Based Professional Learning Community Project (“project”) is an example of a learning community activity that encourages teachers to participate in Process 2 and Process 3 activities (Timperley et al., 2007). During such a project, a small group of teachers conduct an investigation of a teaching and learning problem they are familiar with.

Learning communities are an effective mode of professional development (Bates, 2012; Beatty, 2006; Duncombe & Armour, 2004; Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003; Timperley, 2009). This is, in part, because there is evidence of a direct relationship between teachers who learn together and resultant improvements in student achievement (Hirsh & Killion, 2007). Successful collaborative professional learning teams focus on analysing the impact of teaching on student learning as well as on challenging problematic beliefs held by teachers (Hunzicker, 2012; Timperley et al., 2007).
Teachers cited offsite courses as their main source of professional development; consequently, they were “unfamiliar with collaborative professional learning as a legitimate form of professional development” (Duncombe & Armour, 2004, p. 156).

Mclaughlin and Talbert (2006) recognised the need for teachers to build a specific skillset for collaborative professional learning, but stated that educational institutions “ignore the challenges entailed in developing professional learning communities” (p. 38).

Thus far, this introduction has supported an argument that although collaborative professional learning is highly regarded as an effective mode of continuing professional development, there are implementation issues that limit its impact. Furthermore, the collaborative professional development discussed has been concerned with communities of teachers in face-to-face settings and working over an extended period of time. This raises an important question: one that asks how geographically separated teachers might participate in collaborative professional learning.

Today, given the wide availability of digital communication tools, perhaps collaborative professional learning might be conducted online. For example, in one recent case, Brunei in-service teachers in a continuing professional development programme successfully conducted online discussions about practice, and created wikis to represent their collective knowledge (Moroney, 2010). Based on this experience, it does appear that online collaborative professional learning might hold the promise of making professional development more accessible and less costly for geographically separated teachers.

This study was conducted in the small South East Asian state of Brunei. This study investigated how small groups of teachers might form and develop learning communities that used online facilities for communication. The research participants for this study were 53 teachers from 30 state secondary schools of Brunei. The researcher was the professional development provider and instructor of a professional development programme that all research participants took part in. Thus the author adopted both a researcher role and an intervening participant in the development of teacher learning communities. It is important to acknowledge this interventionist stance of the researcher given he had a hand in the design of the learning community environments he was researching (Barab, Schatz, & Scheckler, 2004). The research was conducted after the completion of the professional development programme. Ethical considerations were taken into account to ensure that no harm might come to the human participants in the
study. A full review of the ethical considerations of the study are available in section 3.14.

1.2. About the Researcher

The researcher is an ICT/Educational technology lecturer at the University of Brunei. He works in the Faculty of Education where he teaches in-service teachers in the Master of Education (Educational Technology) programme. He also runs educational technology professional development programmes for in-service teachers in Brunei. The author has a strong interest in e-Learning, and has spent a number of years researching in this area. In recent years, since 2006, the researcher has been particularly interested in the use of online learning communities to support teacher professional development.

Ethics approval was obtained from the University of Auckland Human Participants Ethics Committee. The welfare of research participants in this study was of paramount importance to the researcher (who was also the professional development provider for research participants). Further details about the ethical aspects of this research are presented in section 3.14.

1.3. The Brunei Professional Learning Ecosystem

The research participants for this study were teachers engaged in a professional development programme, during which they generated the data used for the study. This section helps to define the context of the study by defining some of the general characteristics of professional development in Brunei. Appendix K presents further details about being a teacher in Brunei.

The Brunei Ministry of Education in Brunei has mandated that every education officer (teacher) must complete a minimum of 100 hours of professional development per year. The nature of this professional development is mostly restricted to workshops.

Workshops are usually attended by representatives of schools, who then go back to their workplace to share what they have learned with their colleagues. The content of professional development programmes is mostly directed towards putting in place new classroom practices that teachers must follow (Ministry of Education, 2008).
Concerns have been voiced regarding the content, mode, duration, and effectiveness of current Brunei professional development practices (Moroney, 2010; Moroney, Koay, & Boorer, 2009). In fact Brunei Teachers’ opportunities for professional learning appear to be limited by a number of barriers that teachers do not have the wherewithal to overcome, including school policy, practices, and culture; community expectations of what teachers are expected to know and be able to do; institutional dependence on high stakes examinations; and vertical (hierarchical) management structures that appear to limit professional development to somewhat dated and ineffective delivery methods.

There is also a class of barriers to professional learning that to some extent, teachers can overcome. These include: the language proficiency of non-native English speakers, multiliteracies, inquiry mindedness, data awareness, ICT knowledge and skills, access to technology platforms for online community learning, capacity to learn collaboratively, problem solving capacity, and time management skills.

Therefore, given the nature of the professional development ecosystem just described, it is likely that teachers new to online collaborative learning would need to spend time in the beginning of professional learning programmes developing capacity to learn collaboratively online. It is only after an introduction to online collaborative learning that it might be possible for teachers to tackle the thorny questions about teaching and learning in Brunei classrooms. In essence, it appears to be the case that it is essential that the goals of professional learning are achievable when a learning community is at the beginning of a journey along a developmental trajectory; learning goals being related to developing the capacity of a community to learn rather than finding solutions to teaching and learning problems.

If professional development in Brunei was to be described in a single sentence, it would convey the notion that institutional barriers are preventing teachers from being able to participate in quality professional development. Given this situation, it is imperative that Brunei teachers are provided with a different, approach to professional learning that provides the “space, time, place, and intellectual capital to succeed” (Wright, 2010, p. ii). Learning communities in online settings have the potential to make a real difference in the quality of professional learning for Brunei teachers, overcome many of the barriers to professional learning thus mentioned.
1.4. Significance of the Study

The overall objective of this study is to make a significant contribution to knowledge about the characteristics of effective professional development. In particular, this study aims to provide new knowledge — both theoretical and methodological — as to how small teams of teachers develop the capacity to learn together in an online setting. There are several reasons why this focus has been chosen. Firstly, from a personal perspective, the researcher has spent nearly three decades in educational settings which have made little or no allowance for the professional development and support of geographically isolated teachers in small rural schools. These teachers may benefit considerably from the operationalization of online learning communities. The functioning of learning communities needs to be underpinned by theory, something to which this study aims to contribute.

Secondly, there is recognition of the need to develop theory regarding learning communities *per se*, as there is insufficient theoretical underpinning to adequately explain collaborative professional learning at this time (Kirschner & Lai, 2007; Rhodes & Beneike, 2002).

The paucity of information currently available to schools in the United Kingdom concerning implementation issues, desirable working standards, and the skill and training requirements of staff responsible for helping colleagues learn, needs to be addressed if the potential benefits of these mechanisms are to be realised. (Rhodes & Beneike, 2002, p. 303).

Some literature has supplied rudimentary guidelines that describe the functioning of online learning environments (see Barab et al., 2004). However, it remains unclear how such communities are created and how they evolve (Hlapanis & Dimitracopoulou, 2007).

Certainly, there is the need to theorize the task-tool relationship as it applies to knowledge building in online settings with a view to, amongst other things, ensuring the right tools are chosen, and that productive pedagogies used (Lund & Rasmussan, 2008).

Thirdly, there are tensions in an online community that are not present in communities that meet face-to-face, and these tensions may need to be properly understood if online communities are to be successfully operationalized (Richard Dufour, Dufour, & Eaker, 2008; Kopp & Mandl, 2008). Given the current rush to use social networking tools for the
professional development of teachers, it does seem there is an urgent need to establish the extent to which this rush is in the right direction.

1.5. Practical Challenges of the Study

The researcher provided research participants with tools they could use for online collaborative learning, while at the same time limiting opportunities for face-to-face meetings between teachers. For example, one of the conditions or rules of this study was that no two teachers from the same school could belong to the same learning community, thereby ensuring that teachers from the same learning community would not be meeting face to face in the same school. However, it was not possible to prevent teachers talking to each other when they really wanted to (using whatever method they chose to), and it also wasn’t possible to limit teachers to using the supplied communication tools. Therefore, it is the case that not all communication metadata and transcript content was available to the researcher.

Content analysis subjectivity is to be considered a limitation of the research as influential studies have found it is difficult to code computer-moderated communication (CMC) transcripts, resulting in issues of “objectivity, reliability, and systematic consistency” (Garrison & Anderson, 2005, p. 132).

English is a second language for all teachers in this study, as it is for all Bruneian teachers. Therefore, due to translation and elaboration issues, text messages (written in English) may not have accurately reflected the views of the teachers who wrote them. It was a continuing challenge to determine the contextually loaded intent of content posted by teachers during online discussions.

1.6. A Dual Track Professional Development Pipeline

Data for this study was generated by teachers when they participated in “projects” during a professional development programme that ran from January 2011 to September 2011. A project, in the context of this study, was a dual track professional development pipeline that consisted of: (1) a combination of an investigation of the knowledge building capacity of a learning community; and (2) an investigation of a teaching and learning problem. The main goal of this professional development programme was to improve the capacity of learning communities to build professional knowledge effectively.
Some key developmental challenges faced during the professional development programme were to:

- Foster ownership and participation. Teachers in a community needed to take responsibility for developing the learning capacity of their community.
- Focus on Inquiry. Teachers needed to participate in ongoing capacity building activities that improved the quality of investigations (about teaching and learning and about the collective knowledge building of the community).
- Focus on real world issues. Teachers needed to develop the capacity to address real classroom problems taken from their own classrooms.
- Support for a community of purpose. Teachers in a community were focused on a specific and well defined teaching and learning problem rather than generic problems.

Teachers were provided with a number of tools they could use to help them to complete projects. Firstly, they were provided with a guideline for completing an evidence-based professional learning conversation about a teaching and learning problem. A second guideline showed teachers how to investigate the knowledge building capacity of their community. Thirdly, each community was supplied with a book called the *Professional Learning Communities: An implementation guide and toolkit* (Foord & Haar, 2008).

Learning was defined to be changes in knowledge, attitudes, skills, aspirations and behaviours (Killion, 2008). From the knowledge perspective, teachers in this study might develop new, more effective ways of learning collaboratively online than they had previously used.

Teacher attitudes and beliefs in any current project were likely influenced by their cumulative experiences from earlier projects.

From the skills perspective, teachers need to learn how to use a number of tools to be able to begin to participate in a learning community. For example, teachers needed to learn how to accurately interpret online discussion contributions given that some teachers may not be familiar with the linguistic code shifting practices teachers use when communicating textually online.
From the aspiration perspective, in-service teachers might wish to adopt the concept of a learning community if they can see real value in belonging to one. Adoption might be more likely if learning community goals are achieved.

From the behavioural aspect, teachers develop a set of tools, rules, processes and procedures that advance the knowledge building capacity of their community. Some of the processes and procedures they develop will relate to teaching and learning investigations. For example, teachers may need to learn techniques for collecting baseline data about a teaching and learning issue they wish to investigate. Other processes and procedures will be developed to improve the operation of their learning community. For example, teachers might create rules for their learning community to ensure that activities are completed in a timely manner.

The professional development programme can be described in terms of a contradiction teachers faced that was the impetus for their development of learning communities (Table 2).

<table>
<thead>
<tr>
<th>Contradiction</th>
<th>New Concept</th>
<th>New Tools</th>
<th>Obstacles</th>
<th>Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irregular opportunities for collaborative professional learning although such professional learning is highly valued.</td>
<td>Online learning communities</td>
<td>Guidelines for conducting a project and guidelines for assessing learning community performance</td>
<td>Complexity of online collaborative professional learning</td>
<td>Effective collaborative professional learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instruments for assessing learning community readiness to begin knowledge production activities</td>
<td>Steep learning curves for some individuals and some online learning communities</td>
<td>Personalised professional learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cultural and historical barriers to collaborative professional learning</td>
<td>Changes in classroom practices</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Achievement of desired student outcomes</td>
</tr>
</tbody>
</table>

The new concept (for these teachers) was a self-directed dual track professional development pipeline. The first track of the pipeline focused on developing online professional learning capacity within their small team of teachers (learning community). This was both a prerequisite and a co-requisite for completing the second track. Teachers needed to acquire online collaborative learning skills and knowledge, learn how to negotiate and represent new collective knowledge in a digital knowledgebase, and learn
how to pool their resources to achieve learning goals with minimal facilitator assistance. The second track focused on addressing teaching and learning challenges that Brunei teachers think are important.

The professional development instructor (and later, the researcher) played a facilitating role by providing a website where teachers could participate in learning community activities, by conducting workshops, and by organising sharing sessions where teachers from different learning communities described what they had been able to learn.

The learning journey for each OLC was unique to that particular group of teachers. Each OLC set itself different professional learning goals, and developed their own ways of best achieving these after taking into account OLC contextual factors such as the preferred ways teachers communicated online, familiarity with technologies, availability of bandwidth, organisational skills and problem solving skills.

Although teachers in a learning community appeared to have a common teaching and learning objective to achieve, the professional learning that they experienced was largely going to be a journey into the unknown. During this journey teachers learned things as and when they needed to know. This unexpected, serendipitous learning happens during projects as and when new knowledge is required “just in time” to complete an activity at hand.

As there was no central core of knowledgeable experts in a learning community (as might be expected to be found in a community of practice) learning communities appeared to be better described as an entity whose collective knowledge was distributed amongst its’ expert teacher members.

A characteristic of these learning communities was that knowledge was distributed amongst the expert members of the community, and that collective knowledge building involved harnessing such knowledge effectively to address the problem at hand.

Teachers in learning communities had multiple opportunities to develop their professional knowledge during their professional development programme. They began their PD with a series of 8 workshops (3 hours each) over two months during which they learned a range of skills and knowledge about how to participate in a learning community and how to conduct a teaching and learning investigations. During workshops teachers were able to share their ideas and experiences with all teachers in the PD programme and
went through the complete cycle for completing a project. Following two months of workshops, teachers continued to meet (for 5 months) to present their monthly OLC project results. These presentation sessions included question and answer sessions where teachers could learn about the experiences of other OLC teachers. Each OLC needed to produce two reports at the end of each project. These reports were a summary of the teaching and learning investigation and a summary of the CLP investigation of their OLC. Reports were shared with all PD teachers to read. Teachers were provided with written guidelines for conducting evidence-based professional learning conversations and for conducting OLC performance investigations. Each school participating in the PD received a copy of a book about professional learning communities that included numerous tools that they could use to evaluate the functioning of their OLC (Foord & Haar, 2008). In addition, each OLC needed to present their PD to the general teaching population in their school.

The professional development that learning communities engaged in had some of the characteristics of participatory inquiry/action research and “study groups.” Inquiry/action research is defined by Guskey (2000) as a cyclical five step process of selecting a teaching and learning problem and determining an action to take. One of the criticisms of this approach to professional development is that it takes considerable commitment, effort and time on the part of individual teachers, and that an enabling environment is not always available (Broad & Evans, 2006).

There are aspects of a “study group” orientation to the professional development as well. According to Broad and Evans (2006), study groups focus on teaching and learning problems of common concern to teachers. They go on to say that although such groups lessen isolation of teachers, focus on ongoing learning, and promote coherence of learning, there are also challenges to overcome in study groups, such as the chance that individual effort may be discouraged by dominant members, or that new professional knowledge may be opinion-based rather than evidence-based. The professional development programme the teachers in this study participated in is more fully described in Section 3.9.
1.7. Collaborative Professional Learning Theory

Two major collaborative professional learning theories; Professional Learning Community (PLC) theory and Community of Practice (CoP) theory are mentioned in educational literature as supporting the collaborative professional learning of teachers. Although most CoP and PLC literature largely goes into explanations of face-to-face implementations, it may nevertheless be the case that one or both might contribute substantially towards an understanding of online, collaborative, professional learning communities. One of the purposes of this thesis is therefore to determine what contribution CoP and PLC theories might make to an understanding of online learning communities.

Communities of practice theory and professional learning community theory are presented in sections 2.4 and 2.5 respectfully, and then contrasted and compared in section 2.6. The following two sections, 1.13 and 1.14, present brief introductions to PLCs and CoPs.

1.8. Professional Learning Communities

Professional learning communities (PLCs) have been defined as an in-school professional development orientation towards professional learning that enables teachers to learn together collaboratively (Richard Dufour et al., 2008). PLCs have been used for professional development in schools to support increased commitment to the mission and goals of a school, to reduce teacher isolation, to promote shared responsibility for the development of students and collective responsibility for students’ success (Louis & Marks, 1998). PLCs are usually implemented using face-to-face collaborative learning activities, such as staffroom meetings, and departmental teaching and learning projects are often the vehicle that promotes professional learning. It is likely that PLC literature may, to some extent, contribute to an investigation of how learning communities work. In deed the question arises (to be addressed in this study) as to what extent a PLC theory might be extended to accommodate online PLCs, or whether PLC theory is so far removed from explaining how learning communities work that it is better to look to other collaborative learning theory that explains learning communities. A more detailed presentation of professional learning communities is available in section 2.4 of the following literature review chapter.
1.9. Communities of Practice

A community of practice, for the purposes of this study, is a group of teachers that share a common interest in advancing knowledge about teaching and learning. Much has been written about the use of communities of practice to promote the professional learning of teachers (Correia & Davis, 2008; Evans & Powell, 2007; Foulger & Williams, 2007; Hlapanis & Dimitracopoulou, 2007; Kelly, Gale, Wheeler, & Tucker, 2007; Kirschner & Lai, 2007; MacDonald, 2009). Given that there is support in the literature for the use of communities of practice for collaborative professional learning, it raises the question as to what extent community of practice theory is sufficient to explain how online learning communities might work. A summary of community of practice literature is presented in section 2.5 of the following literature review chapter.

1.10. Cultural-Historical Theory of Activity Framework

It can be overwhelming to investigate all the features of an online learning community (OLC), as it could have been in this study if not for the use of mechanisms to control the investigation process. Such online communities are complex, constantly evolving, and subject to transformational tensions between different constituent parts and outside forces. Fortunately, a frequently used analytical lens is available that can be used to inform investigation of learning communities.

The Cultural-Historical Theory of Activity (CHAT) framework has been used as an analytical lens for research about online learning communities (Barab et al., 2004; Benson, Lawler, & Whitworth, 2008; Fiedler, Mullen, & Finnegan, 2009; Lund & Rasmussen, 2008; Meyers, 2007). Adopting this approach, the CHAT framework, presented in sections 2.3 and 3.2.1 has been used extensively throughout this study as an analytical lens for examination of learning communities.

1.11. Web Tracking Statistics

One of the advantages of a learning community being online is that there is the opportunity to capture data that might be used to identify the location of a learning community on a developmental trajectory. If this was the case then such information could be used to identify strategies for advancing a learning community along its individual developmental trajectory. Both community of practice theory and professional
learning community theory suggest that collaborative professional learning capacity evolves in developmental stages over time. Therefore, if learning communities develop over time also, it may be helpful to be able to locate a learning community on its developmental trajectory, and thereafter determine what the best course of action might be to move the OLC forward.

Web tracking statistics provide a detailed record of levels of participation and the types of activities that teachers participate in, providing valuable clues about the characteristics of a learning community at a given point in time. Therefore bearing the above in mind, it is worthwhile to investigate the extent to which such automated analysis results might be used to help a learning community to reach an optimal professional learning state quickly.

1.12. Research Questions

As mentioned, much has been written about the use of learning communities as a form of professional development, but that there is little literature that indicates how communities may be developed. It is, for example, not clear what competencies teachers require to be able to participate in knowledge production and few tools that professional developers might use to operationalize online learning communities.

With this in mind, the researcher, in this study, intended to consider whether or not it is plausible to build on Community of Practice Professional Learning Community theory to explain online learning communities, and to determine the extent to which other learning theories, such as expansive learning (Engeström & Sannino, 2010) might better explain a learning community phenomenon.

1.12.1. Research Question One

To what extent do the collaborative professional learning characteristics identified in community of practice and professional learning community literature apply to communities of learning in the online environment?

1.12.2. Research Question Two

To what extent may web tracking statistics be used to locate an online, collaborative, professional learning community on a developmental trajectory?
1.13. **Overview of the Methodology for the Study**

This research investigated the performance of small communities of Brunei teachers as they engaged in online, collaborative, professional learning activities over a seven-month period. Research participants were provided with a protocol for conducting online, evidence-based, professional learning conversations, and access to a website created for the research that included facilities for online synchronous and asynchronous communications.

Data was collected digitally from a number of online sources, including web server logs, uploaded documents, online discussion transcripts, e-mail correspondence, and research field notes. Some data was also collected from a questionnaire designed to gather demographic information and participant views of their own experiences with technology. The questionnaire was used to gather information about independent variables that were applied during analysis.

Several different data analysis techniques were used in this study. Firstly, quantitative data stored in web server logs were analysed using SPSS and Excel. Secondly, content analysis of discussion transcripts and participant reports was conducted using Atlas Ti version 6. Data triangulation and multiple methods were used to answer research questions in the belief that this was appropriate in complex educational settings, such as the online social constructive learning environment of this study. Results were then compared and contrasted to determine the extent to which existing theory explained the findings.

The researcher decided that a mixed methods is an appropriate approach for this study. Mixed methods are commonly associated with research that aligns with a pragmatic worldview. Accordingly, qualitative and quantitative analysis approaches are used as and when they help to answer the research questions under investigation (Creswell & Plano Clark, 2007). This is “almost” a multi-strand sequential design in the sense that the conclusions that are made on the basis of the results of a first strand lead to identification of data sources for a second main strand. However, qualitative and quantitative data collection takes place concurrently at different stages of the study and in that sense the study has some of the characteristics of a typical concurrent mixed methods design. Quantitative and qualitative data is collected in the form of questionnaire responses (QUAL and QUAN), discussion transcripts (QUAL), written reports (QUAL), wikis
(QUAL and QUAN) and web tracking data (QUAN). In the last analysis stage of the study an inference (meta-inference) is developed from an integration of the separate qualitative and quantitative strands of the study.

It is expected that there may be some literature to support findings, that findings may contradict existing theory, and that given the lack of research in this area, there will be findings present in the literature that have not yet been mentioned.

1.14. Organization of this Thesis

This thesis is divided into nine chapters. Chapter 1 is the introduction, which presents an overview of the research and its purpose. It presents the context of the study with particular reference to being a teacher in a Brunei secondary school.

Chapter 2 reviews the literature relevant to a study of online, collaborative, professional learning communities. It primarily refers to literature in the fields of Cultural-Historical Theory of Activity, professional learning communities, communities of practice, and computer-supported, collaborative, learning theory. Gaps in the literature were identified to justify the research questions to which the study seeks to provide answers.

Chapter 3 describes the methodological choices made that informed the design of the study. It also describes the development of data collection instruments, instruments for evaluating OLC development, and data collection techniques and procedures. Chapter 3 also describes the use of web tracking statistics, content analysis, and use of the constant comparison method to process discussion transcripts.

Chapter 4 describes the digital data collection and analysis techniques used in the study, and include the use of Moodle web server logs, the use of LimeSurvey online survey software and the use of Atlas Ti (Version 6) for qualitative analysis of textual data.

The results of the study are presented in Chapter 5, Chapter 6 and Chapter 7. Chapter 5 presents the results from a TPACKBRU questionnaire to define the setting for the study. Chapter 6 focuses on the results of analysis of Moodle server logs to determine similarities and dissimilarities of high and underperforming online, collaborative, professional learning communities. Chapter 7 presents the results of case study analyses of both a high-performing community and an underperforming community. It describes success factors that are associated with effective learning communities.
Chapter 8 discusses the findings with reference to the literature reviewed in Chapter 2. Chapter 9, the concluding chapter, summarises the study as a whole and discusses the implications for policy and practice and the contribution to the literature. Suggestions for further research and limitations of the study are identified.

1.15. Summary

This chapter presented some of the contextual factors that impact on the way teachers in Brunei conduct professional development. Collaborative professional learning, communities of practice and professional learning communities were all briefly introduced as important theoretical frameworks for the study. The research questions under investigation were identified, and their importance to an understanding of learning communities was presented. The research methodology was briefly defined, including the use of the CHAT framework as an analytical lens. The next chapter presents the results of a literature review of the study topic.
Chapter 2. Literature Review

2.1. Introduction

This chapter is a review of literature to contextualize the research undertaken in the current study. This study, which examines the use, structure, and implementation of online collaborative learning, may be explored through many different theoretical lenses. Overall, the research has a socio-cultural frame, which recognises social and cultural influences within a context (Vygotsky, 1978; Wertsch, 1985). Three specific theories were selected as having the potential to inform this study: Community of Practice (CoP) theory, Professional Learning Community (PLC) theory, and Cultural-Historical Theory of Activity (AT). When taken together, the three theoretical frameworks may provide a richer view of community activity than any one alone might offer.

The remainder of this chapter begins in Section 2.2 with a discussion about the place of collaborative professional learning in current teacher professional development literature; Section 2.3 then follows with a review of cultural historical activity theory, which has largely been used as an analytical lens throughout this study. Section 2.4 presents a discussion about professional learning communities, that is largely informed by Richard Dufour et al. (2008). Section 2.5 presents is a review of Community of Practice theory that is largely informed by Wenger, McDermott, and Snyder (2002). Section 2.6 defines the differences between the professional learning communities and communities of practice concepts that the author has drawn upon throughout this study. Section 2.7 describes how Computer Supported Collaborative Learning theory may inform online collaborative professional development. Section 2.8 explores the concept of expert teams (sometimes called knowledge building communities), which in the context of this study, may be a group of teachers collaborating to find answers to teaching problems. Section 2.9 describes evidence-based professional learning projects. Section 2.10 introduces some of the unique challenges teachers need to overcome when they move professional learning from a face to face setting to an online setting. The chapter concludes with a summary in Section 2.11.

2.2. Learning in a Community

As mentioned in Chapter 1, there is agreement amongst many educational researchers that teachers can develop professional knowledge when they collaborate with each other to
investigate authentic teaching and learning problems (Guskey, 2000, 2002; Parr, Timperley, Reddish, Jesson, & Adams, 2007; Timperley, 2009; Timperley & Earl, 2009; Timperley et al., 2007). Additionally, it has been reported that collaborative professional learning is effective when it is focused on improving desired student outcomes (Timperley, 2008). Adey (2004) highlighted the importance of informal social learning when he proclaimed that “the best experience that teachers have in in-service courses is talking with other teachers” (p. 10). The serendipitous learning Adey observed occurred during coffee breaks and evening meals, perhaps illustrates the sociocultural and organic nature of social learning.

Despite reported successes, there is also evidence of failed learning communities. In a Dutch study, it was found that many teachers enjoyed strong and persistent support for learning communities, but that a significant number of teachers was found to remain autonomous and isolationist (Louis & Marks, 1998). The adoption of collaborative professional learning per se is insufficient to guarantee effective knowledge production will take place (Loucks-Horsley & Matsumoto, 1999; Timperley, 2008) and therefore there is a clear need to better understand what competencies are required by teachers when they create a learning community (Graham, 2007), and the capacity building activities that might reliably bring a learning community to an optimal level of development where it is able to sustain professional knowledge building capacity.

Efforts to identify a set of (reported) teacher competencies for learning communities is somewhat confounded because collaborative learning studies are very different from each other, and definitions of collaboration and learning vary considerably. Additionally, the scale of collaboration varies from a few teachers to communities of many thousands, and also, researchers have conducted investigations using a wide range of theoretical lenses (Dillenbourg, 1999).

2.2.1. Characteristics of Effective Learning Communities

Various characteristics of online learning communities are mentioned in the literature. These include that teachers are required to have high levels of interaction and participation in a collectively oriented knowledge producing community (Salmon, 2005). Additionally, it is reported that community size matters, and that different sized communities produce knowledge differently (Lund & Rasmussan, 2008).
According to Kopp and Mandl (2008), groups of three of four teachers are optimal for knowledge production activities, though literature suggests there are a range of views on the numbers. Certainly, there are a lot of tasks to complete, and roles to be assigned when a community learns online, and therefore it follows that the fewer the number of teachers in a team the more they each have to know and the more roles they will have to adopt.

Ideally, the goals of a learning community are coherent with the institutional professional learning aspirations of the teachers’ workplace, though there is a view that this may induce standardization of practices at the expense of innovation and creativity (Foulger & Williams, 2007).

Trust between teachers (friendship networks) is an important characteristic of effective learning communities (Borgatti & Foster, 2003; Plauborg, 2007). However, beyond trust, there is the need for teachers to feel comfortable about challenging the views of others (Foord & Haar, 2008; Timperley & Earl, 2009). It is out of such dissonance that new knowledge emerges (Cragg, Dunning, & Ellis, 2008; Harmon-Jones & Mills, 1999; Stahl, 2008).

A sense of communityness is a characteristic of effective learning communities that has two aspects to it; an element of participation, and an element of sociability (Ke & Hoadley, 2009). Nothing was found in this review to indicate what impact “outliers” may have on the performance of a community. That is to say, it is unclear what happens when members of a team are either very much more active (dominating) than others, or when participants are largely invisible in online knowledge production activities.

It is apparent that the visibility of community members needs to be managed. Visibility in learning communities is important as it is the only way that teachers are able to tell if others are participating. At the same time, the visibility/invisibility paradox (Jameson, 2011) suggests that leaders in a community should leave others to contribute (hands off) to support consensus-based knowledge production. If teachers in a community are unaware of the visibility/invisibility paradox then it follows that a community’

A Community which has a set of agreed values is able to meet the needs of teachers (Ke & Hoadley, 2009). When teachers lack common values then it may be difficult for a learning community to settle on common learning goals (Foord & Haar, 2008). This is
especially the case when teachers have very different agendas when they participate in
their community (Acemoglu, Ozdaglar, & ParandehGheibi, 2010).

Collective intentionality is the focus of all teachers on achieving the same community
learning goals (Correia & Davis, 2008; Hall, 1985; Ke & Hoadley, 2009). Intentionality
is linked with collective values and strong social bonds between teachers (Correia &

Teacher engagement in inquiry learning activities is a characteristic of effective
professional development (Earl & Timperley, 2009b; Timperley et al., 2007; Wright,
2010), as it is for teachers in learning communities. However, for such inquiry to be
effective it is necessary that teachers have the skills to participate in collective knowledge
production (Stahl, 2008). In deed online systems such as CSILE have been developed to
facilitate collaborative knowledge building (Scardamalia, 2004) while others have
supported such activities with carefully designed protocols that guided teachers through a
process for solving problems (Timperley, 2009).

The appropriateness of technology platforms and applications has a bearing on what
processes teachers can bring to bear when they engage in knowledge production. For
example, the availability of high bandwidth makes it possible to synchronize offline and
online knowledge production activities (Scardamalia, 2004).

Teachers that do not have strong collaborative knowledge production skills, and are
unfamiliar with ICTs may have a considerable amount to learn (cognitive/learning load)
before they become effective community members (pre-training). If teachers find they
are overwhelmed with more to learn than they can manage then it may not be possible for
the team to achieve desired professional learning outcomes (Lund & Rasmussan, 2008).

Indeed, the tools teachers use, and the way they use them (the tools-task relationship) has
a large impact on how the team goes about producing knowledge, and the extent to which
they are successful in such endeavours (Barab et al., 2004; Lund & Rasmussan, 2008).

Given that teachers work collaboratively in a learning community, and that there are often
multiple roles allocated to different teachers in the same team, it is important that
individual teachers manage their time effectively if the goals of the community are to be
achieved (Kapitzke & Pendergast, 2005; Lacey, 1996).
Teachers need to be able to use ICT tools to create and share information, to locate and evaluate information, to search, sift and sort information, to use ICTs to research and solve problems, and to send and receive messages. Teachers also need to be able to critically understand and use information from multiple multimedia sources (Carr, 2008). Teachers are therefore required to be familiar with Information literacy, media literacy and ICT literacy if they are to successfully participate in learning communities (J. Anderson, 2010).

Leadership and organisational practices are two of the factors that determine the developmental trajectory of a learning community (Graham, 2007). According to Graham, leadership practices serve to create a foundation for collaboration in a facilitative rather than a causal way. According to Parry, leadership involves creating commitment to the community from teachers, requiring that teachers collaborate and support for the development of communityness. In some instances poor leadership, by forceful agents, may sway a community towards acceptance of incorrect and inaccurate beliefs (Acemoglu et al., 2010). One approach to ensuring this doesn’t happen is to ensure that community knowledge production is built on the bedrock of sound reasoning and supporting evidence rather than the shifting sands of personal opinion, personal agendas and guesswork (Earl & Timperley, 2009b).

According to Borko (2004) professional learning for teachers should be intensive, of extended duration, and content focused, if teachers are to advance pedagogic knowledge and change their classroom practices. Desimone (2009) described successful professional learning as being content focus, involving active learning, being coherent, of extended duration, and involving collective participation. Roberts and Pruitt (2009) also reported that it is important that learning community activities are inextricably intertwined with day-to-day teaching, therefore suggesting schools need to support a learning culture amongst staff.

### 2.2.2. Learning Community Models

A number of learning community theories are currently supported in the literature. For example, according to Foord and Haar (2008), teachers may learn together in a professional learning community. Lave and Wenger (1991) reported learning taking place in a community of practice, while Stahl (2004) and Salmon (2005) reported learning taking place in a computer supported collaborative learning environment. Scardamalia
(2002) described how expert teams developed collective professional knowledge, while Engeström and Sannino (2010) described expansive learning.

When a learning community is viewed through the prism of expansive learning theory (Engeström, 2007; Engeström & Sannino, 2010) then teachers seek new ways of adjusting the way that they deliver teaching services, and they are also seeking new ways of collaborating together to do so. In this sense then the object of learning is transformed from looking solely at how to develop more effective teaching practices to including the process reengineering associated with finding new ways of collaboratively developing valued learning experiences for students. This is an ongoing cyclical and iterative process that involves a feedback loop of evidence of learning from classrooms where approaches to teaching are tested. Other professional learning goals associated with expansive learning might include developing capacity to: create partnerships; support flexible professional learning practices; to engage in cycles of professional learning actions; cross departmental and institutional boundaries, and to build networks (Engeström & Sannino, 2010). In essence, learning communities identify new collective professional learning goals that extend what was previously learned in previous activity cycles are based on what the community during cycles of activity during which they redefine the way they learn and what they hope to achieve in that learning.

Collaboration is frequently associated with approaches to professional learning in online settings (Kopp & Mandl, 2008). The complexity of online learning communities may limit their effectiveness if participants of such communities are unaware of how to make them work effectively. Simply providing online communication facilities is obviously necessary for online collaboration, but is, in itself, insufficient for communities to progress (Richard Dufour et al., 2008; Leonard & Leonard, 2003). Teachers will, for example, need access to communication tools, and knowledge of how to use these for knowledge building in an online setting.

A review of literature has revealed that for teachers to learn collaboratively online, using an evidence-based professional learning conversation protocol, they may be required to have the following competencies:

(1) Multiliteracies so a teacher may correctly interpret and create online textual representations (Hammett, 2007; Timperley & Earl, 2009);
(2) Meta-cognition skills so teachers participating in collaborative professional learning can evaluate their own collective and individual professional knowledge advancement practices and processes (Ke & Hoadley, 2009; Wachob, 2010);

(3) Planning skills so that professional learning projects reach a satisfactory conclusion (Scardamalia, 2002);

(4) Research skills for looking at evidence of learning (Bernhardt, 2005; Lai & McNaughton, 2009; Mandinach & Honey, 2008); and

(5) Community building skills to enable participation and sustainment of a community (Hlapanis & Dimitracopoulou, 2007; Salmon, 2005; Swan et al., 2008).

In addition, school leadership and institutional organisational factors influence the extent to which collaborative professional learning may take place (Graham, 2007). Therefore, given the literature about competencies required for online learning, it is a natural extension to develop a tool (rubric) that provides an indication of the readiness of a learning community for online learning. Learning communities with insufficient of the competencies listed above, or those that lack sufficient operational and technical support (context of learning) will need to establish the conditions for online learning before attempting to complete an online, evidence-based investigation of a teaching and learning problem.

Given the range of competencies required of teachers in a learning community, it is fair to say that designing inclusive and effective online professional development programmes remains a complex process (Opfer & Pedder, 2010). It is likely, for example, each teacher may initially have only a subset of the competencies required to participate in her learning community, and therefore, each teacher may require a personalised learning programme to develop required competencies.

There is consensus that learning communities develop over time, and this is frequently modelled as a sequential process. The five stages of the model of teaching and learning online (Salmon, 2005) suggests that learning communities go through five (sequential) developmental stages. Salmon also reports that the most effective knowledge building occurs at stages four and five. Furthermore, she suggests that it is only in stage five that
learning communities are able to evaluate and develop their own knowledge building capacity.

**Figure 1.** Model of teaching and learning online (Salmon, 2005)

This researcher suggests that access and motivation (Figure 1) more logically comes about after development of the skills required to be able to participate in an online learning community. A lack of professional learning success, brought about by a lack of familiarity with the tools, processes, culture and rules of a complex learning community, is surely a disincentive to continued participation. Providing knowledge about successful learning communities, and providing teachers with the wherewithal to participate in their own communities (skills and tools), along with strategies for evolutionary development of collective knowledge building capacity (based on expansive learning) may be an alternate approach to learning community development that resonates well with teachers that have to adapt and whatever they learn to the context of their own classroom and school.

### 2.3. Cultural-Historical Theory of Activity

*Cultural-Historical Theory of Activity* (AT) is a sociocultural framework for a complex and collaborative human act that has its historical roots “grounded in the Russian cultural historical psychology of Vygotsky, Leont’ev, and Luria” (Engeström, 1999, p. 20).
AT has been used with good effect as an analytical lens for studies of online learning communities (Barab et al., 2004; Carugati et al., 2008; Engeström, 1999; Fiedler et al., 2009). AT has also been used as a design framework for online discussions (Wang, 2008). It has been used in research studies to develop context-sensitive insights that showed an appreciation of the nature of tools, rules, and roles at a micro-organisational level, while at the same time, highlighting the influence of macro-organisational activity systems on communities of teachers learning together for professional development purposes (Benson et al., 2008). AT has also been used in online, distance learning studies (Dillenbourg, 1999). This cultural-historical theory of activity has developed into an international and multidisciplinary area of research that has had a significant impact on fields of inquiry such as teaching and learning (Engeström & Miettinen, 1999).

Engeström’s CHAT framework may be used to model a network of teachers (such as a learning community) as an interaction between subjects (teachers), the object which is being acted upon (OLC), the tools a community uses for communication, the community within which interaction is embedded, the rules and protocols that guide community behaviour, and the ways that the community is able to manage people and resources to complete activities within a specified timeframe (Fiedler et al., 2009).

The CHAT framework diagram, shown in Figure 2, depicts an Activity System (AS) as the interaction of six nodes: subjects, tools, object and outcomes, rules, community, and division of labour (Barab et al., 2004; Fiedler et al., 2009).

![Figure 2. The Activity System Triangle](image)

There are tensions within each node and three further sources of tension that serve to catalyse transformation of an AS.
The second source of tension is between nodes and is represented as arrows in Figure 2. For example, observation of a learning community may reveal that the learning load associated with developing online communication skills and learning how to use digital tools (tools-subject tension), may be overwhelming for them. It is therefore necessary for those concerned with professional learning capacity (including a learning community itself), need to carefully consider the cognitive load capacity associated with the use of specific tools (Paas, Renkl, & Sweller, 2004). Cognitive load theory further posits that the digital tools that teachers select to use for learning have the power to both enhance learning, or when used inappropriately, degrade learning (Mostyn, 2009).

The third tension is between the activity system under investigation and other external activity systems (Community node). Fourthly, there is inertia within an activity system that limits the rate at which an activity system may be able to change. These tensions, when heightened or reduced, provide continuous transformation of the activity system in ways that may afford or constrain activity system outcomes (Meyers, 2007).

The way the author has used the CHAT framework in this study is similar to the way that Barab et al. (2004) used the CHAT framework to investigate an online, collaborative, professional learning community of teachers. In their study, Barab et al. (2004) described their online learning community as a sociotechnical integration network (STIN) of teachers designed for promoting online inquiry learning amongst science teachers wishing to share and improve their teaching strategies.

In this context of the learning communities of this study, the division of labour node focuses on the extent to which teachers collaborate or cooperate (see Figure 3). It is essential that learners recognise the difference between collaboration and cooperation if they are to “engage in reflective collaborative, problem solving activities” (Duncombe & Armour, 2004, p. 146). When teachers cooperate by dividing up tasks (division of labour) to complete a collective work objective, little in the way of collaborative professional learning may take place. In this study the community node highlights the interaction the OLC has with external activity systems — such as the schools that teachers work in.
Teachers interact with multiple activity systems concurrently, and each of these activity systems has specific goals and agendas that is usually different to that of a learning community activity system. For example, the school a teacher belongs to is in itself an activity system, as is the department within the school that a teacher belongs to. The OLC focuses on developing collaborative professional learning capacity between teachers from different schools, and on finding a solution to a teaching and learning problem. A school may be more focused on examination performances, or other alternate goals.

2.4. Professional Learning Communities and Professional Development

According to Michael Fullan, much seminal work about professional learning communities has been produced by Ruchard DuFour and his colleagues (Fullan, 2006).

The gold standard for fostering the development of PLCs comes from the activist work of Richard Dufour and his colleagues. Their latest offering, Learning by Doing: A Handbook for Building Professional Learning Communities, is a powerful contribution to the field. Having led the development of PLCs in both elementary and secondary schools and now being associated with pockets of successful examples across all levels. (Fullan, 2006)
Fullan goes on to describe how DuFour has identified six core characteristics of effective professional learning communities: focus on learning; a collaborative learning culture; inquiry into best practice; learning by doing; commitment to continuous improvement; and focus on results. In addition, in a later edition of the same book, the authors report that it is necessary that the mission, vision, values, and goals are well defined in an effective learning community (Rebecca Dufour, Eaker, & Many, 2010).

Others have have produced variations of the characteristics highlighted by DuFour. For example, A professional learning community is a group of teachers, in a single school, who collaborate in a professional learning process (Foord & Haar, 2008). Professional learning communities are formed to solve teaching and learning problems in a specific school setting (Roberts & Pruitt, 2009; Yasumoto, Uekawa, & Bidewell, 2001). A school itself may operate as a professional learning community, and within the school community there will likely be multiple departmental level professional learning communities.

Teachers of a professional learning community might be expected to engage in some or all of the following activities:

1. observing other teachers teaching,
2. planning lessons with other teachers,
3. giving and receiving feedback from colleagues,
4. conducting action research,
5. mentoring new teachers,
6. coaching one another,
7. keeping a reflective log,
8. developing and maintaining a professional portfolio, and
9. looking at student work with other teachers (Roberts & Pruitt, 2009).

In addition to the above, collaborative professional learning is underpinned by the notion that within a school there are experienced teachers who can share knowledge with others, and when sharing takes place, teachers “collaborate, reflect, and learn from each other” (Duncombe & Armour, 2004, p. 144). Teachers share beliefs and a knowledge base of common understandings; there are high levels of participation and interaction within a professional learning community; there is a level of interdependence between
professional learning community teachers; and there is acceptance of individual and community views (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006).

The above discussion raises the issue of how the goals, purpose, and objectives of a small departmental professional learning community might be set, and how the acceptance of individual and community views might come about. If there is undue pressure on a small departmental professional learning community to conform to institutional level professional learning community goals, this may reduce the cohesion and intentionality of a departmental community (Correia & Davis, 2008), thereby reducing its effectiveness, and ultimately, its sustainability. Whereas alignment with an institutional mission is desirable, it is clearly better if departmental teachers have a say in how they themselves can best do this.

Professional learning communitys may support change in schools, or they may be used as a tool to reinforce existing practices. Although there is a feeling that professional learning communities somehow improve student learning outcomes, there is very little in the way of empirical evidence to support such claims (Stoll et al., 2006).

Of particular interest in the context of this study, it has been shown that individuals have the opportunity to gain knowledge when they discover and explore differences of opinion with colleagues (Compton, Davis, & Correia, 2010). In such a setting, teachers are able to negotiate new collective meaning through online discourse (Gunawardena, Lowe, & Anderson, 1997). Dissonance theory provides an alternative to the idea that learning takes place when experts disseminate best practices to teachers as passive recipients of wisdom. According to Festinger’s theory of cognitive dissonance, the existence of dissonance is uncomfortable for an individual, and this discomfort motivates the individual to seek new understanding that may explain (and reduce) that dissonance (Harmon-Jones & Mills, 1999).

Ultimately, professional development is designed to lead to improved student learning performances. Four factors have been reported by (Yasumoto et al., 2001) to influence the extent to which professional learning community activity leads to improvements in the academic performance of students: (1) problem solving efficiency, (2) cumulative exposure, (3) pedagogical interference, and (4) induction of trust. Each of these four factors is now discussed.
2.4.1. Problem Solving Efficiency

If a group of teachers are collectively good at solving teaching and learning problems, and if there are high levels of interaction between individuals, then individual classroom teaching and learning performances should benefit (Loucks-Horsley & Matsumoto, 1999; Wellman, 1988; Yasumoto et al., 2001).

Specifically, powerful learning has been found to take place when teachers adopt an inquiry approach, when the principles of active learning are adopted, and when teachers use “artefacts of practice such as student work” (Loucks-Horsley & Matsumoto, 1999, p. 264).

Problem solving strategies, such as the Projects of the current study, are strongly supported in the literature (Earl & Timperley, 2009b; Guskey, 2000; Little & Curry, 2009; Timperley, 2009; Timperley et al., 2007).

However, it is also the case that “transforming data to usable evidence and knowledge for educational improvement requires engagement in complex technical and interpersonal processes” (Timperley & Earl, 2009, p. 121). What is also essential, according to Timperley and Earl, is that teachers collect appropriate data to analyse, that teachers have inquiry habits of mind (rather than being fixed-minded), and that there are relationships of respect and challenge between collaborating teachers (that support constructive discussion between teachers with differing views).

2.4.2. Cumulative Exposure

When teachers share and develop teaching and learning knowledge as a part of ongoing professional development over an extended period of time then individuals tend towards the use of common pedagogical approaches for similar teaching scenarios (Yasumoto et al., 2001). Repeated use of a new teaching practice (cumulative exposure) will generally increase the chance that the practice is adopted as a standard approach to learning. However, it is important to note, that cumulative exposure per se is just as likely to reinforce bad practices as it is to reinforce positive changes in practice (Yasumoto et al., 2001).
2.4.3. Pedagogical Interference

Some instructional techniques may produce demands upon students to the extent that students may be forced to channel more energy and time into one subject at the expense of engagement in other subjects. This pedagogical interference is amplified if a new pedagogical practice is introduced across multiple subjects. For example, encouraging a large amount of reading may be manageable if confined to one subject, but when several subjects concurrently demand more reading then students may become overloaded (Yasumoto et al., 2001).

2.4.4. Induction of Trust

From the induction of trust perspective, teachers need to believe they can rely on their colleagues to behave in ways that support the goals of their professional learning community (Yasumoto et al., 2001). Developing deep understanding of teaching and learning happens when relationships of respect and challenge have been formed (Timperley, 2009). That is to say, reaching a point when teachers feel safe enough to be able to reveal their true beliefs about teaching and that when challenging others, providing evidence for their beliefs is also acceptable to their colleagues.

The learning that is to take place in an online setting is likely to be influenced by factors in addition to the four just discussed; these include the characteristics of any communication technologies to be used, social and psychological characteristics of technology users, and group characteristics (Gunawardena et al., 1997).

This section has briefly touched on some of the main features and constraints of professional learning communities. However, while there is much to be taken from professional learning theory that might explain how offline professional learning communities work, there are crucial differences between online and offline communities that such theory does not appear to explain at this time.

2.5. Community of Practice Theory and Professional Development

A Community of Practice (CoP) was originally defined to be a group of people who share a common interest they wish to pursue, or a problem (community focus) they wish to resolve over an extended period of time (Lave & Wenger, 1991). When teachers can join with colleagues in collaborative professional learning to share ideas and improve teaching
practices, then a CoP may emerge to support the on-going professional development of individuals (Beglau et al., 2011). A CoP for teachers may be expected to provide teachers new to a field of study with access to established best practices and to the professional support of experienced teachers (Compton et al., 2010).

A CoP may be a small group of teachers who have worked together for a long time, or it could be all the teaching staff in a school (Duncombe & Armour, 2004). However, usually, school CoPs are subject-focused and likely to be made up of the members of a subject department who share a common purpose and a collective goal (Field, 2012).

Over time, teachers develop shared beliefs, values, experiences, and common practices (Hlapanis & Dimitracopoulou, 2007). Teachers will share and develop knowledge collectively, and store the sum of community knowledge in a repository accessible to all teachers; a CoP will need to find appropriate social structures for creating and sharing such knowledge (Wenger et al., 2002).

There are uncertainties about whether communities are emergent or created by design. In CoP literature from New Zealand, it appears at least some communities are purpose-built organizations educators use to explore work practice issues (Lai, Pratt, Anderson, & Stigter, 2006). Alternative descriptions of CoPs report them as being emergent rather than designed (Ke & Hoadley, 2009).

There is the notion that the aim of a CoP is to promote “homogeneity of beliefs, practices, and attitudes as an outcome” (Borgatti & Foster, 2003, p. 997). This suggests that all knowledge in a CoP is in some way centralised in a community knowledge base, and that individuals do not hold community knowledge themselves. An alternate view is that community knowledge is distributed amongst the members of the community, as would be the case if the distributed cognition view of information storage is supported (Angeli, 2008; Schwartz, 2008). In such settings, it is not necessary that individuals are aware of all the knowledge available to community members, but that they know who does, and how they might acquire it as and when they need to (Scardamalia, 2002). In a community, it may be preferable that at least some of Scardamalia’s notion of expert teams is adopted as the original source of information. A trusted expert will surely be able to convey the true meaning of information to learners more accurately than if non-expert learners were to rely solely on their personal interpretation of textual information.
Communities of practice are dynamic entities that are sustained by high levels of participant passion, interest, and support — all of which vary over time. It has been reported that a CoP goes through five stages of development, as shown in Figure 4 (Wenger et al., 2002, p. 69). The optimal developmental stage for a CoP is called stewardship, during which time there is the greatest likelihood of the CoP achieving its knowledge development aspirations.

![Figure 4. Communities of practice stages of development](image)

Before reaching the stewardship development stage, CoPs go through a potential stage, a coalescing stage, and a maturing stage. During the potential stage, a social community with a common interest explores the possibility of collaborating to achieve common aspirations. At the coalescing stage, CoP members have committed to working together to achieve common aspirations. During the maturing stage, the community develops procedures, processes, and tools for CoP participation that help the community to achieve its goals. The most productive stage is called stewardship, during which time, collective knowledge building is most effective:

…communities typically undergo several changes in their focus, relationships, and practice. They commonly shift from sharing ideas and tips to stewarding their practice – building refining, and expanding the domain and its relationship to other domains. They move from a loose network of personal relationships to a
group with a common sense of identity, combining intimate knowledge of each other’s approach with a sense of collective responsibility for the domain. (Wenger et al., 2002, p. 111)

Implicit in the notion that a CoP goes through different developmental stages is the need to be able to establish at which stage a community is functioning at a given point in time. If one knows the stage of development for a community, then one also knows the main developmental tensions the community is tasked with addressing, and therefore, strategies that might be employed to help CoP members to advance their community to the next developmental stage.

Several researchers have developed checklists that can be used to indicate whether or not a CoP has reached the stewardship developmental stage. For example, Kopp and Mandl (2008) reported four common characteristics found in effective CoPs: (1) goal orientation; e.g. “I identified myself with the group goal”; (2) task completion; e.g. “…the priority was task solving”; (3) cohesion; e.g. “we communicate freely”; and (4) taking responsibility; e.g. “I tried to complete assigned tasks.” Soller and Lesgold (2007) described four strategies for effective CoP collaboration: (1) construction, (2) criticism, (3) accumulation, and (4) motivation. These complementary checklists are useful for evaluating a CoP; however, they may be insufficient to guarantee successful online communities of practice functioning. For example, Salmon (2005) suggested there is a need for a community manager role, and Wright (2010) described technological challenges and the need for CoP members to be multiliterate if they are to be able to communicate effectively in an online setting.

The development of an understanding of communities for professional development is informed by the literature regarding how teachers create new knowledge and skills. Several professional development models exist that have characteristics in common with characteristics described in the preceding CoP discussion. There is ample literature to support the concept of professional development being focused on collaborative learning in schools, that it is long-term, and that professional development content is determined by teachers (Adey, 2004; Borko, 2004; Desimone, 2002; Guskey, 2000; Hew & Brush, 2006; Loucks-Horsley et al., 2003; Marx, Freeman, Krajcik, & Blumenfled, 1998). However, the concept of online communities of practice is at best ill-defined, and there remains insufficient theory in current CoP literature to explain such communities.
2.6. Contrasting Communities of Practice with Professional Learning Communities

Communities of practice and professional learning communities have much in common in terms of purpose and organisation, and these similarities have led some educational researchers to use the terms interchangeably. For example, while talking about communities of practice, McLaughlin and Talbert (2006) refer to such communities as “professional learning communities” (p. 38). However, despite this somewhat confounding observation, an attempt is made in this section to describe the differences (apart from their different origins) between what many people say constitutes a community of practice, and what others say is a professional learning community.

The main difference between a community of practice and a professional learning community is that the primary focus of a professional learning community is that of student learning, while the primary focus of a community of practice is more likely related to work practices in non-educational organisations (Wubbels, 2007). According to Wenger et al. (2002), the major characteristics of a CoP are:

1. a focus on innovation and learning;
2. they are emergent rather than designed;
3. they require institutional support if they are to survive;
4. community members provide strong support for community ‘aliveness’ through eliciting passion and active participation from members; and
5. Communities are constantly addressing the tension between the needs of the community of practice that sometimes compete with needs of the institutions in which the community members work.

In addition, long-standing members of a CoP share tacit knowledge of best practices and processes to those new to the community. Of importance to this study was that all research participants were new learning community members, and there were few if any experts in communities who were able to share tacit knowledge about how a community should operate.

In contrast, professional learning communities are specifically designed to support development of teachers that will, in turn, lead to students achieving desired learning outcomes (Richard Dufour et al., 2008). The common characteristics of a professional learning community are:

1. focus on student learning;
2. a shared (institutional level) purpose or mission that is replicated at the school department level;
3. a clear vision of what the desired outcomes of PLC activity must be;
4. clear goals and measurable objectives;
5. a collaborative learning culture;
6. commitment to continuous improvement; and
7. results orientation.

Professional learning communities are designed and woven into the fabric of an institution; they are implemented to bring about change in schools.

This discussion has highlighted how both PLC and CoP literature have indicated support for learning and innovation. However, a PLC is entirely focused on student learning in a specific educational setting; it is designed and controlled rather than emergent; and there is a strong institution-management link present in PLCs to ensure that departmental PLCs align their community goals with an institutional mission. This focus on single institutional goal alignment presents challenges for teachers from different schools that want to learn together.

CoPs are not necessarily designed with student learning, or even education in mind. They are traditionally viewed as supporting the transmission of best practices and knowledge from old hands to new members of a profession. Both CoPs and PLCs have the potential to promote professional learning goals in face-to-face settings. However, this literature review has demonstrated that neither CoP nor PLC theory satisfactorily informs the design of online professional learning communities.

2.7. Computer Supported Collaborative Learning

In recent times, there has been growing support for computer supported collaborative learning (Chai & Tan, 2006; Hoppe, Ogata, & Soller, 2007; Kopp & Mandl, 2008; Lund & Rasmussan, 2008; Stahl, 2004). Online learning communities are an increasingly important feature of the educational landscape (Ke & Hoadley, 2009). Computer supported collaborative learning, as a research area, has gained the attention of experts in a wide range of fields including instructional designers, software developers, educational psychologists, educational technologists, learning theorists, and computer scientists. Interest in computer supported collaborative learning, from the teacher education perspective, appears to lie in the belief that “computer supported collaborative learning appears to be one of the most promising ways, not only to promote, but also to achieve
desired changes in teaching and learning practices” (Lipponen, Hakkarainen, & Paavola, 2004, p. 31).

One commonly used computer supported collaborative learning approach favours the use of discourse by members of a team in order to create individual meaning through the construction of shared artefacts (Dougimas & Taylor, 2002). For example, professional development participants may collaborate online to jointly publish a wiki (digital artefact) that is representative of the negotiated collective knowledge of the group. Angeli (2008), described such communities from an activity system perspective that she calls distributed cognition.

The distributed cognition approach to learning may explain much of how knowledge is produced in a learning community. This is because the collective knowledge of a community is in part made up of tacit knowledge held by individual community members. These highly contextualized and nuanced understandings may be difficult to represent in textual form, and therefore, much may be lost in translation when tacit knowledge is explicated. It is thus the case that at least some portion of collective knowledge will be held by individual experts within a community, and that colleagues draw on this knowledge as and when they need it.

Since its emergence in 1996, a number of different views of computer supported collaborative learning have developed. For example, Lipponen et al. (2004) identified three computer supported collaborative learning frameworks: the acquisition framework, participation framework, and the knowledge creation framework.

From the acquisition framework perspective, the learner may be thought of as a passive receiver of transmitted knowledge. The mind of the learner is “a container of knowledge, and learning is a process that fills the container” (Lipponen et al., 2004, p. 33), the tabula rasa concept. Technology, in this case, is used to reinforce outdated pedagogical practices that facilitate surface level canonical learning. For example, learners may log in to a learning management system to download articles stored in an online digital repository. From the professional development perspective, use of the acquisition framework may well be unhelpful when the aim of training is to encourage teachers to develop the habit of an inquiring mind.
From the participation framework perspective, the notion that collaboration might be a good way to learn has been highlighted by many researchers (Adey, 2004; American Educational Research Association, 2005; Borko, 2004; Dougimas & Taylor, 2002; Engeström, 1999; Lave & Wenger, 1991; Lipponen et al., 2004; Stahl, 2004; Vygotsky, 1978; Wenger, 1998; Wertsch, 1985). The participation framework is representative of the way new in-service teachers commonly develop knowledge and skills of teaching and learning. More experienced teachers share their knowledge, experiences, and dispositions in an approach that is close to that which Lave and Wenger (1991) called situated learning through legitimate peripheral participation. However, this approach to professional development appears to have shortcomings; for example, the participation approach does not support innovation and creativity by teachers, but rather, the transference of existing knowledge and best practices to all teachers within a community.

From the knowledge building framework perspective, teachers in a professional development setting may be expected to come together specifically to advance collective professional knowledge (Lund & Rasmussan, 2008; Scardamalia, 2004). Several modes of online social discourse may be useful for knowledge building including the use of tools for video conferencing, mind mapping, online chatting, online discussions (asynchronous), and wiki development.

2.8. Knowledge Building in Expert Teams

The skills and knowledge learners need in the knowledge age are different to those required in the past. When today’s learners process multimedia content they need to understand aspects of communication such as agency, motivation, gaps and silences, cultural norms and historical influences (Wright, 2010). In essence, learners need to know how to communicate effectively and learn collaboratively in a variety of online and offline settings (Angeli, 2008; Bereiter & Scardamalia, 2003; Scardamalia, 2002). A part of learning collaboratively includes the ability to elaborate and write coherently, to speak effectively in group settings, and to moderate personal goals in the interests of group success.

An expert team is a group of individual specialists who form a cohesive, largely independent workplace unit. Expert teams are made up of inquiry-minded and inventive
problem solvers; and for team members, the goals of the team are more important than individual goals.

Expert teams exhibit continual learning, flexibility, good thinking, and collaboration, but they also exhibit characteristics of a more distinctive nature. Although each member of the team may have particular expertise and particular duties, the team teachers are also able to take over for one another on a moment-to-moment basis. This provides a flexibility that enables the group effort to succeed despite unexpected complications (Scardamalia, 2002, p. 67)

Expert teams in business organisations serve as models for the kinds of communities that are expected to carry out higher level work in knowledge-based enterprises. They comprise people who are committed to doing whatever is necessary to make the team effort succeed. Collective cognitive responsibility then refers to the condition by which all teachers in a community share responsibility for the group’s learning performance rather than concentrating responsibility in a leader or other higher authority.

Although teachers may not appear to place much focus on developing their own groups problem solving skills, they have always supported the notion of collective cognitive responsibility in other ways (Bereiter & Scardamalia, 2003; Graham, 2007; Hlapanis & Dimitracopoulou, 2007; Scardamalia, 2002; Vescio, Ross, & Adams, 2008; Wright, 2010). For example, teachers take collective cognitive responsibility for knowing what is to be assessed in a test or examination, and for knowing which teachers to disseminate assessment details to.

2.9. Evidence-Based Professional Learning Conversations

There is support for the notion that professional development programme design should be informed by the teaching experiences and classroom needs of teacher professional development participants (Adey, 2004; Earl & Timperley, 2009a; Loucks-Horsley et al., 2003). Also, there is a strong argument that links evidence-based discussions by teachers to the sustainability of new classroom pedagogical practices (Foord & Haar, 2008; Timperley et al., 2007). Therefore, professional learning community investigations (projects) that focus teachers’ attention on analysis of student data gathered from the classrooms is an approach to professional learning that is widely supported (Hirsh & Killion, 2007; Lai & McNaughton, 2009). Such investigations are discussions between
teachers who are “grounded in evidence and focused on learning from that evidence” (Earl & Timperley, 2009a, p. 2).

“… real benefits can accrue from “getting to know” data as part of an on-going process of educational change using it locally to investigate real issues in particular schools, as a way of deciding what to do next.” (Earl, 2009, p. 45)

In a typical project, one member of a learning community supplied scanned images of student work (evidence) to the rest of her group to highlight her assertion that students had significant difficulties with the language used in science. She also provided information about the context in which the artefacts were produced, including classroom practice details, resources used, information about student activities, and the duration of work, as well as a description of the physical teaching environment. The expected learning outcomes associated with artefact production were also explicitly stated. She also provided some information about the particular group of students that had generated the artefacts. All teachers in the OLC then individually analysed the data to form their own views of what they believed the problem to be. Not everyone drew the same conclusions about what caused the science language issue, and how it might be addressed, and this dissonance fuelled a search for understanding and clarity about the problem and what might be done about it.

2.10. Online Conversations

Online social networking tools would appear to offer the opportunity for a teacher to geographically and culturally extend his or her professional learning conversations beyond the immediate environment (Mancio, Delfino, & Mazzonit, 2009; Schlager, Farooq, Fusco, Schank, & Dwyer, 2009). However, it is as yet unclear to what extent this promise is realizable in practice, given current technologies and what qualities a social learning environment requires for it to be effective in this context (Angeli, 2008; Carr, 2008; Chan, Hew, & Cheung, 2009; Ke & Hoadley, 2009; MacDonald, 2009).

Some recent research about communities has focused on the complexities of the developmental trajectory of an online community and the characteristics of successful learning communities. Some characteristics have been identified; the failure of some communities has been linked to a lack of shared community goals, a lack of culture about reflective practice, and unfamiliarity with technologies (Kelly et al., 2007).
Other researchers have linked the creation and evolution of a community to being codetermined by its level of cohesion and the shared goals of its community members (Correia & Davis, 2008; Henri & Pudelko, 2003). The following diagram (Figure 5) shows how a CoP may evolve as learners coalesce into a cohesive unit while at the same time ensuring the community has a well-defined purpose.

![Diagram of community evolution](image)

**Figure 5.** Context of emergence of virtual communities (Henri & Pudelko, 2003)

While Figure 5 shows cohesion and intentionality are characteristic of effective online learning communities, there are likely to be others (Dillenbourg, 1999). A virtual community whose function is to build collective knowledge will, amongst other things, require facilities for high levels of interaction between participants (Salmon, 2005), and access to facilities, processes and procedures that promote the co-construction of knowledge (Stoll et al., 2006).

There is clearly a gap in the literature between what is currently known about communities and what is required to inform their design. The researcher found no literature regarding the features and constraints of different tools community members might use, and very little literature about the conditions required to create, develop, support, and sustain communities.

### 2.11. Summary

This chapter began with an argument that collaborative professional learning, when used to investigate authentic teaching and learning problems, and when focused on desired student outcomes, is an effective approach to professional development of teachers. It also identified literature that reported that research literature has reported that successful
collaborative professional learning programmes are intensive, of extended duration, coherent, and intertwined with day to day teaching. A caveat around the use of collaborative professional learning was that collaboration for learning is necessary but insufficient to lead to achievement of desired student outcomes. The collaborative professional learning needed to be focused on achieving desired student outcomes, and it needed to address issues that were relevant to the specific needs of individual teachers.

Several collaborative professional learning delivery modes were identified, including professional learning communities, communities of practice, computer supported collaborative learning and expert teams. Expert teams are associated with the concepts of distributed cognition and distributed cognitive responsibility, both of which might be used to contribute to an understanding of learning communities.

Teachers engaging in online collaborative professional learning require skills and knowledge that may be new to them, and that they will need to learn if they are to participate (e.g. multiliteracies, meta-cognition skills, planning skills, research skills and time management skills).

The case was put for the use of cultural-historical theory of activity to be used as an analytical lens for the study.

Collaborative professional learning in schools is frequently associated with theory about communities of practice or theory about professional learning communities. Although these two theories have much in common, they also have differences, and these have been highlighted in this review. The review of communities of practice and professional learning communities was somewhat confounded by a lack of convergence towards common definitions of what these terms mean. The researcher defined that he would use two authoritative sources for this purpose (Foord & Haar, 2008; Wenger et al., 2002).

Computer supported collaborative learning is put forward as another collaborative professional learning approach that has a supporting body of educational research literature. The acquisition framework, participation framework and knowledge creation frameworks were put forward as modelling different computer supported collaborative learning approaches. The ideas of distributed cognition (Angeli, 2008) and collective cognitive responsibility (Scardamalia, 2002) were introduced as providing an understanding of how a learning community might work.
A strong case was presented for the need for professional development to involve evidence-based professional learning conversations that would help ensure that teachers engaged in professional learning activities that were focused on solving problems that were of interest to them, and that would be focused on achieving desired student outcomes.

Some of the primary issues associated with professional learning in online settings were then highlighted, including the need for explanation about how communities engaged in the co-construction of professional knowledge online. This led to consideration of tools-task relationships, and how the selection of tools influenced the outcomes of professional development. Very little literature addressed the tools-task relationship, and yet this is logically a characteristic of effective online learning communities.

Though many theories exist that explain aspects of online collaborative professional learning, no single learning theory was identified as being able to satisfactorily explain this phenomenon. It is therefore worthwhile to consider how a unifying theory about online, collaborative, professional learning might be developed. It is with this in mind that this study proposed to contribute to an understanding of how online collaborative, professional learning communities might be created and sustained.
**Chapter 3. Methodology**

**3.1. Introduction**

This chapter is divided into 15 sections. Section 3.2 presents the philosophical underpinnings and assumptions of the use of mixed methods within the context of an investigation of online, collaborative, professional learning communities (OLCs). This section also presents an outline of how the study was conducted. Section 3.3 describes the development of a questionnaire, called TPACKBRU, which was used in the main study. Section 3.4 describes the development of a collaborative professional learning community development indicator (OLCDI). Section 3.5 describes the use of web tracking statistics derived from Moodle server logs. Section 3.6 presents the procedures for completing the first of two phases of the main study. Section 3.7 presents the case study analysis processes of the second phase of the main study. Section 3.8 describes the unit of analysis as the OLC. Section 3.9 describes how the professional development programme was the source of data for the study. Section 3.10 describes the dependent and independent variables used in analysis. The professional development programme is presented as the source of data for the study. Section 3.11 describes the data collection processes adopted for the study. Section 3.12 links the data captured, and data analysis processes to how the research questions are answered. 3.13 presents arguments for the selection and analysis of two OLC case studies. Chapter 3.14 presents the ethical position adopted by the researcher for this study. The chapter concludes with a summary.

**3.2. Research Methodology Rationale**

The researcher chose a worldview based on pragmatism for this study. The pragmatist tradition was selected because it most satisfactorily described the philosophical foundations of the different research methods used by the researcher.

According to the pragmatist tradition, research focuses on practical outcomes that might lead to change or changes in practice (Creswell & Plano Clark, 2007). Therefore, in the pragmatist tradition, it is the research questions rather than a particular methodological stance that are of primary importance (Arnon & Reichel, 2009). A researcher may, therefore, use as many research techniques as required to complete an investigation based on practicality, feasibility, and productivity as decided by that researcher (Creswell & Plano Clark, 2007; Teddlie & Tashakkori, 2009).
A worldview may be described in terms of characteristics that differentiate it from other worldviews. For example, Cresswell (2008) described post positivist, constructivist, and pragmatic worldviews in terms of their ontological, epistemological, axiological, methodological, and rhetorical characteristics. Researchers choosing to employ a *mixed methods* model most often follow the rules and norms of the pragmatist tradition (Johnson, Onwuegbuzie, & Turner, 2007). Pragmatic worldview characteristics are described in the remainder of this subsection.

The ontological position for the pragmatic world view is that there are both singular and multiple realities (Johnson et al., 2007). Therefore, pragmatists believe that neither the post positivist position of singular realities nor the constructivist position that reality is shaped by individual experiences is true all the time.

The epistemological position for the pragmatic worldview is that the distance between researcher and participant is determined by *what works*. For example, under different circumstances, the researcher may visit teachers in their schools to collect data, or, to better answer a given research question, they may observe participants impartially and objectively without directly communicating with them (Creswell & Plano Clark, 2007).

The axiological position for the pragmatic worldview is that researchers may choose under what circumstances to work closely with participants (Castro, Kellison, Boyd, & Kopak, 2010). Mixed methods research is particularly well suited for exploring how individuals make sense of their experiences when they participate in interviews or answer questionnaires (Bergman, 2010). In such circumstances, a researcher may work closely with participants to obtain data to enable the analysis of participants’ views in order to inductively generate new theory and generalizations (Creswell & Plano Clark, 2007).

The methodological position for the pragmatic worldview is that researchers collect both quantitative and qualitative data and that these are in some way mixed during analysis (Ivankova, Creswell, & Stick, 2006). When quantitative and qualitative results are compared, there may be convergence, contradiction, or inconsistency that the researcher can use to construct superior explanations of the phenomenon being investigated (Johnson et al., 2007).

The rhetorical position for the pragmatic worldview is that there will be times when it is necessary to use formal notation (for example, when describing the results of statistical
testing), and that at other times, it will be more appropriate to employ an informal style of writing (Creswell & Plano Clark, 2007). The formal notation of statistical analysis reporting is sufficiently defined and standardized so that, in some cases, statistical software packages generate results that may be directly copied into research publications (Carver & Nash, 2012). However, no such clearly defined guidelines and standards exist to guide qualitative research reporting.

This researcher chose a mixed methods design for this study as this is the research paradigm most often associated with pragmatism (Johnson et al., 2007). A mixed methods research design refers to a protocol in which the investigator collects and analyses both quantitative and qualitative data in a single study (Creswell & Plano Clark, 2007). Such a design approach affords the researcher the opportunity to combine the clarity of quantitative results with the nuances made possible through qualitative reflections (Wheeldon, 2010).

3.2.1. Cultural-Historical Theory of Activity Framework

The CHAT framework (Figure 6) was first introduced in section 1.15, and then in more detail in section 2.3. This section defines how the CHAT framework was used in this study.

![Figure 6. The CHAT framework](image)

For the current study, the Subjects node is a learning community comprised of three to six Year 7 science teachers. No two teachers in the same group came from the same school, although it was likely two teachers from different learning communities taught at the same school.
The *Tools* node defines the online tools, as well as other enabling tools that teachers might use for conducting OLC activities. The digital tools available to participants were online chat, online discussions, and wikis. Other tools might include linguistic code switching that is commonly used in online social networking settings where text is the most common mode of communication.

The *Object* node was the motivation for conducting professional development in a learning community; which in this instance was to change the OLC itself into a more effective knowledge building entity. The object may have been defined to be a professional learning community conversation, or a teaching and learning investigation, or the conversations teachers conducted to develop their sociotechnical interactive networks (Barab et al., 2004). However, given that the motivation of teachers likely plays a highly significant part in the success of online learning communities it was decided that the object of activity systems would be teachers’ interest in developing the capacity to learn collectively online.

The *Community* node was the external activity systems or people that contributed to the way learning communities functioned. For example, a learning community may be influenced through communication with other learning communities and through communication with experts. Certainly, communities had ample opportunity to do this during monthly sharing sessions when each group produced a presentation and two reports to be shared with all other groups. Other community resources included school administrators, university researchers, and school colleagues.

The *Rules* node referred to community-defined rules for participation. For example, a community might have decided that it was necessary that all members participate in online discussions.

The *Outcome* node describes the desired professional learning outcomes to be achieved by each community: (1) movement along a developmental trajectory that advanced community capacity to generate collective knowledge, (2) capacity to conduct evidence-based solutions to teaching and learning problems, and (3) Advancement of community knowledge about their learning community and new knowledge about a possible solution to a teaching and learning problem they have investigated.
According to activity theory, a community is motivated to change by four layers of tensions (Fiedler et al., 2009). The first layer of tension lies within each of the nodes of the CHAT framework. For example, if teachers brought together to form a learning community have significantly different values then this may impact on their collective capacity to learn together.

The second tension layer is one in which any two nodes are inconsistent. These tensions are represented by the arrows between nodes in the CHAT framework diagram shown in Figure 6. For example, if there are too many rules (rules node) for teachers to have to follow then teachers may find that they may no longer be motivated (object node) to learn collaboratively. At the same time, an absence of any rules, protocols and guidelines may mean that teachers are unclear what they need to do, and this may also affect their motivation to participate in collective knowledge building.

A third tension layer is one in which traditional ways of doing things are in conflict with a new way to perform an activity. For example, there may be tension within a community as they search for effective ways to communicate online when less tech-savvy teachers voice their preference for offline forms of communication or alternatives they are familiar with that do not leave behind a digital footprint a community may use for later reflection.

In the fourth instance, there may be tensions between the expected outcomes of different activity systems. For example, in the professional development programme associated with this study, each community needed to generate knowledge about teaching and classroom practice for Year 7 science teachers. However, the school activity system to which community teachers belong might be more interested in direct links to improved student performance in high stakes examinations, and could view supplementary classes for students rather than their own professional development as the way to achieve that aim.

The CHAT framework was used to inform the design of questions that were employed to try to understand the extent to which a community was able to complete the AT object activity (complete a project). Community performance was in part measured by answering the questions about OLC performance that are presented in Table 4.

Both the following tables, Table 3 and Table 4, were provided to learning communities to guide them through the processes of completing a teaching and learning project and then
carrying out metacognitive activities to review the learning performance of their community. Table 3 was formulated on the premise that participants in conversations need to reveal what they believe and why they hold such beliefs by making their presuppositions, ideas, and feelings explicit. Ideally, participants will discover there are a range of views in their community, at which time they should try to explain why their understanding is preferable to the views of others in their community by referring to the evidence their community has collected (Earl & Timperley, 2009a).

Table 3. Project investigation protocol questions

<table>
<thead>
<tr>
<th>Questions</th>
<th>Further Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What problem was investigated?</td>
<td>The community selected a teaching problem that was (1) of interest to all teachers in the OLC, (2) important to solve, (3) will increase the knowledge and skills of community teachers.</td>
</tr>
<tr>
<td>2. What evidence supported the view that the problem really existed?</td>
<td>OLC teachers needed to provide evidence of a problem. The evidence needed to be raw data rather than processed results. Typical data included scanned images of student work or digital artefacts created by students. The evidence was in digital form so it could easily be shared electronically with all community members.</td>
</tr>
<tr>
<td>3. What did the evidence say?</td>
<td>Each community member explicated their beliefs, feelings, ideas, and presuppositions by making online discussion contributions.</td>
</tr>
<tr>
<td>4. What differences of opinion were identified when views from step 3 were compared?</td>
<td>The community discussed the differences in interpretation of the evidence and sought to understand why these differences existed.</td>
</tr>
<tr>
<td>5. What were the common community views of the problem and the cause of it?</td>
<td>OLC teachers negotiated a common position about what the problem was and what they believed was causing it.</td>
</tr>
</tbody>
</table>
6. What problem solutions were proposed?
OLC participants agreed on alternative (feasible) strategies that might be implemented in a Brunei classroom setting to overcome the problem.

7. What does an implementation and testing plan look like?
OLC teachers designed a plan to implement and test one of the alternatives identified in step 6.

8. What new professional knowledge did your community teachers learn?
The OLC reached a consensus about the new professional knowledge they had acquired that might help them to be better teachers.

The location of a community on a developmental trajectory was in part determined by analysing the transcripts of the discussion topics presented in Table 4. In addition, it was possible to establish how

Table 4. Professional learning community performance analysis

<table>
<thead>
<tr>
<th>Discussion topic</th>
<th>Discussion topic explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Object node</td>
<td>The object for your professional development is the reason that you join want to participate in activities with other members of your group. The reason needs to be clear, simple and regularly reinforced to ensure the community can stay on track. What is that you personally want to achieve? Do you want to complete your projects successfully? Do you want to gain more professional knowledge? Do you want to network with other teachers? What is most important to all the teachers in your team?</td>
</tr>
<tr>
<td>2. Subjects node</td>
<td>The subjects for this professional development programme are teachers who belong to a community. What characteristics of your team supported efforts to complete projects successfully? What positive things can you do about relationships in your team that might help your community to be more effective learners?</td>
</tr>
<tr>
<td>3. Rules node</td>
<td>What rules did your community create to enable completion of projects and to support professional</td>
</tr>
</tbody>
</table>
learning? What rule changes might help to make your community even more effective? (Note that removing rules may help just as much as adding new rules!)

4. Division of labour node

How were tasks allocated within your online community? What roles were created for teachers? Was it enough to have a librarian and a community leader? What role changes and workload allocations do you think will help your community to perform better next time?

5. Tools node

Has your group been able to use the online tools (chat, forum, wiki, etc.) effectively? Are the tools suitable for what you are trying to do? Does everyone in your group use the online tools effectively? What can be done to make use of tools more effective?

6. Community node

Did your community interact with teachers of other professional learning communities or people in other activity systems (like your science department at school)? Was this intergroup communication useful? What will your community consider doing to create a better network of people you can work with effectively?

7. Outcome node

Was your community able to create useful new knowledge about science teaching that teachers could use in their day-to-day teaching? If not, then why not? What new general strategy might help your community to effectively achieve a positive outcome (create new knowledge for teachers)?

8. Tension between tools and object nodes

Were the tools available for conversations suitable for the leadership in your group? Did all teachers make use of the tools properly? What were the positive and negative aspects of using available online tools as far as your group teachers were concerned? How could your group use the tools more effectively?

9. Tension between tools and subject nodes

Were the tools (chat, wiki, and forum) suitable for conducting a professional learning conversation online? Remember that the tools available need to match the resources available to teachers. If teachers do not have broadband, then video conferencing might not be useful. If your community uses the social networking site called Facebook then it may find there isn’t the "digital
10. Tension between tools and community nodes

Was it possible to connect with external activity systems (community) using chat, online discussions, and wikis (tools)? Were the tools available to you suitable for collaborating with teachers of other communities? How did you collaborate with people in other communities? How could this collaboration be made better through adjusting either the community or the tools to be used?

11. Tension between subject and object nodes

To what extent was the community (subject) able to complete an evidence-based professional learning project (object) effectively? Are there characteristics of your community that make completion of a conversation difficult? Perhaps some community teachers do not complete tasks on time. What can your community do to reduce the tension caused by the gap between what your group is capable of achieving and what the community is expected to do?

12. Tension between subject and division of labour nodes

How did the community (subject) decide who would be responsible for what activities (division of labour)? Were all OLC roles adequately filled by teachers of the group? Did everyone in the group contribute equally? Was enough work done to complete professional learning activities adequately?

13. Tension between subject and community nodes

Did your community make good use of external activity systems to help your community to complete their project? Were your community teachers able to network effectively with teachers of other communities? What could be done within your community to create a more useful network of people from other activity structures such as school departments, family, friends, colleagues, and so on?

14. Tension between subject and rules nodes

What rules (rules) did the community (subject) create for itself, and to what extent were these accepted and followed by all teachers? How did your group establish rules, and to what extent was it possible the rules created did not suit everyone in the group? For example, there might be a rule that everyone should respond to a discussion thread at least once — however, some

footprint community teachers need to be able to refer back to in their on-going conversations.
<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Tension between rules and community nodes</td>
<td>Were any rules your community adopted consistent with the goal of fostering development of relationships with organisations such as activity structures in your school, other communities, and university staff? How did the rules your community created (if any) affect how much time you had available for interaction in your home activity system?</td>
</tr>
<tr>
<td>16. Tension between rules and object nodes</td>
<td>Completion of online professional learning conversations could be hindered by the rules that teachers of the community have to abide by. For example, if the rules dictate that people must respond to all discussion contributions, then teachers may be procedurally compliant whilst not actually contributing meaningfully to discussions. They may contribute information that shows a shallow level of understanding rather than the deeper understanding aspired to. To what extent, if any, did rules (rules) prevent deep, meaningful discussions during a project?</td>
</tr>
<tr>
<td>17. Tension between community and division of labour nodes</td>
<td>Are community teachers able to complete their project activities, or are they constrained by external activity systems (e.g. school and home activity structures) that limit the time they might contribute to project activities?</td>
</tr>
<tr>
<td>18. Tension between community and object nodes</td>
<td>Is there support for project activities from external entities such as schools, the Ministry of Education, and university research people? Does the school provide sufficient support for community teachers?</td>
</tr>
<tr>
<td>19. Tension between traditional professional development expectations and OLC professional development</td>
<td>Are teachers of your community comfortable with collectively building professional knowledge or do you feel that traditional centralised workshops are more suitable for developing your professional knowledge?</td>
</tr>
<tr>
<td>20. Tension between institutional professional development outcome expectations and professional learning community</td>
<td>Do you feel the 21st century skills and knowledge you learn working in your community will be valued within your school? Do you feel your efforts to improve the way you help children to learn rather than teach to examinations will be understood and valued?</td>
</tr>
</tbody>
</table>
3.2.2. Research Structure

A sequential mixed methods design best describes the design used for this study (see Figure 7). The results of quantitative analysis of web tracking data was used as the basis of selection of two online learning communities to be examined using qualitative analysis of the textual data these groups produced while completing projects. This design was somewhat modified with the addition of a TPACK questionnaire in the first of two phases of the study. Analysis of TPACK questionnaire responses included quantitative analysis of Likert scale question responses and qualitative analysis of TPACK open-ended question responses. This research design required qualitative methods and quantitative methods to be collated and discussed separately in relation to any research findings before being drawn together in an overall meta-inference (Creswell & Plano Clark, 2007; Ivankova et al., 2006; Nastasi et al., 2007; Teddlie & Tashakkori, 2009).

Much research in school/teacher effectiveness has been conducted using mixed methods (Cresswell, 2008). For example, concurrent mixed methods research was used to investigate why schools facing challenging circumstances (such as a significant number of students coming from high unemployment, low socioeconomic backgrounds) chose particular approaches to self-improvement (such as addressing themes related to instructional practice) (Jang, McDougall, Pollen, Herbert, & Russell, 2008). In another example, mixed methods were used to conduct an investigation into the differences between classroom environments in Taiwan and Australia (Aldridge, Fraser, & Huang, 1999). These authors stated that they “drew on multiple research methods that were combined to examine and compare science learning classroom environments” (Aldridge et al., 1999, p. 50).

The current study applied some of the same research methods described in the research conducted by Jang et al. (2008) as well as some additional quantitative techniques for analysis of web server logs. This researcher was interested in pragmatically seeking a solution to important research questions, and to this end mixed methods was, in the researchers view, the best approach to adopt.
This stance [pragmatism] endorses methodological pluralism because, in practice, most research questions cross paradigmatic boundaries. In other words, one should choose methods that are most likely to provide evidence useful for answering important research questions given the inquiry objectives, research context, and the available resources. (Jang et al., 2008)

The main study began after the completion of a preliminary study during which a technological, pedagogical, content knowledge questionnaire was developed. The questionnaire was developed for the purpose of determining the cultural and historical characteristics of participating teachers, and thereby to illuminate the extent to which teachers might have the prerequisite knowledge, skills, and dispositions required of teachers participating in online, collaborative, professional learning activities.

Figure 7. Research design
The technological, pedagogical, content knowledge questionnaire was administered at the beginning of the main study. Two rubrics were then developed during the period of time when teachers were completing projects. The first rubric was developed to identify the extent to which a group of teachers might have the prerequisite skills and knowledge to be able to participate in an online learning community. The results of using this rubric might inform the design of personalised pre-training for teachers to prepare them for participation in online collaborative learning.

A second rubric was developed to establish the location of a community on a continuum from being a new learning community still learning how to learn, to being a well-developed community that has demonstrated it can build new collective knowledge effectively; this was then used to identify a high performing and an underperforming OLC. These two communities were then investigated in depth using case study analysis methods.

Two extreme cases were purposely selected so that a rich data set would be available for analysis (Bryman, 2008). A case study strategy is preferred when there is the need to investigate a concurrent phenomenon in depth, and when the boundaries between context and phenomenon are not clearly defined (Yin, 2009). Rigorous case studies enable researchers to investigate and describe a phenomenon by using multiple sources of data (Baxter & Jack, 2008). Quantitative or qualitative methods may be used to analyse data during a case study (Yin, 2009).

### 3.3. Development of TPACKBRU

The questionnaire developed for this study is called TPACKBRU. Its purpose was to establish (1) Brunei teachers’ perceptions of their technological, pedagogical, content knowledge; (2) demographic information germane to the study; and (3) data about the technological, professional development, and collaborative professional learning experiences of research participants.

TPACK is an acronym for the Technological Pedagogical Content Knowledge Framework (Mishra & Koehler, 2006). It consists of seven knowledge domains that teachers may consider when designing lessons for a technology-enhanced learning environment. The TPACK knowledge domains are (1) Content Knowledge (CK), (2) Pedagogical Knowledge (PK), (3) Technology Knowledge (TK), (4) Pedagogical Content
Knowledge (PCK), (5) Technological Content Knowledge (TCK), (6) Technological Pedagogical Knowledge (TPK), and (7) Technological Pedagogical Content Knowledge (TPCK).

The researcher thought it was important to have an understanding of research participants’ perceptions of their TPACK, as such an understanding could have a bearing on the extent to which participants (1) have the capacity to use technologies to support their online professional learning aspirations, (2) are able to benefit from the professional development programme associated with the research, and (3) adopt online learning communities as a viable form of continuing professional development.

Several self-report TPACK questionnaires have been developed to measure teacher perceptions of their TPACK (Archambault & Crippen, 2009). Archambault and Crippen (2009) developed a TPACK questionnaire for K-12 online teachers to answer, and Schmidt, Thompson, Koehler, Shin, and Mishra (2009) created an instrument for a pre-service primary school teacher audience. Both instruments were made up of Likert scale items that corresponded to the different knowledge domains of the TPACK framework. However, each of these instruments contained some items that were not relevant to this researcher’s target audience of Brunei Year 7 science teachers; therefore, a new questionnaire was developed, tested and then used in the main study.

3.3.1. Adoption of an Existing TPACK Questionnaire

This researcher began TPACKBRU questionnaire development with an examination of each item in the Survey of Pre-service Teachers’ Knowledge of Teaching and Technology (SPTK) (Schmidt et al., 2009). When SPKT items appeared to have face validity, they were copied across to TPACKBRU. Some SKPT items clearly were not relevant for a Brunei science teacher audience and were deleted. Other items were modified to make them clearer for the English Additional Language (EAL) audience of this study. Some new Likert scale items were constructed to support development of reliable TPACKBRU subscales when it was determined there were insufficient relevant items in the SKPT subscales. TPACKBRU items were then tested for reliability and validity and refined as necessary.
3.3.2. Construct Validity of TPACKBRU

According to Teddlie and Tashakkori (2009), construct validity is a measure of how accurately questionnaire items measure a particular variable. Therefore, for TPACKBRU to have construct validity, it was necessary to show that each subscale measured a separate knowledge element of the TPACK framework. Additionally, since TPACKBRU is designed for use by teachers who consider English a second language, it was also necessary to ensure that all items were uniformly understood. To this end, three knowledgeable experts (faculty of education lecturers) considered the face validity of TPACKBRU. After discussions and repeated revision, TPACKBRU evolved into a questionnaire with the same seven subscales titles as its two predecessors from which it was derived, and had 33 Likert type items (see Table 5).

Table 5. TPACKBRU subscales.

<table>
<thead>
<tr>
<th>Subscale Title and Code</th>
<th>Sample item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Knowledge (CK) – 3 items</td>
<td>“I have sufficient knowledge about my subject area.”</td>
</tr>
<tr>
<td>Pedagogical Knowledge (PK) – 7 items</td>
<td>“I can use a wide range of teaching approaches in a classroom setting.”</td>
</tr>
<tr>
<td>Technological Knowledge (TK) – 3 items</td>
<td>“I can find my own solutions to most technical problems.”</td>
</tr>
<tr>
<td>Pedagogical Content Knowledge (PCK) – 4 items</td>
<td>“I know several teaching techniques that are suitable for teaching subject content.”</td>
</tr>
<tr>
<td>Technological Pedagogical Knowledge (TPK) – 5 items</td>
<td>“I can create opportunities for students to use digital technology for individualized learning.”</td>
</tr>
<tr>
<td>Technological Content Knowledge (TCK) – 3 items</td>
<td>“I am familiar with computer simulations and models that may help children to understand subject content.”</td>
</tr>
</tbody>
</table>
Technological Pedagogical Content Knowledge
(TPCK) – 8 items

“I can create technology-enhanced lessons that are student-centred.”

3.3.3. Test-retest Reliability

The coefficient of stability measures the degree of reliability of an instrument when it is administered at different times (test-retest reliability). Ten teachers from schools not included in the main study completed a test-retest procedure to establish the coefficient of stability for TPACKBRU.

3.3.4. Test-Retest Administration Procedure

As a part of the test-retest process, participating teachers provided their email addresses and were then sent a link to the site where they could complete an online version of TPACKBRU. One week later, the same volunteers were sent a second link so they could complete the retest procedure. The Tailored Design Method (TDM) was used to guide administration of the questionnaire. The TDM is a set of guidelines for online survey administration that, when used, should reduce coverage, nonresponse, and sampling and measurement errors (Dillman, Smyth, & Christian, 2009).

3.3.5. Test Retest Results

An analysis using Pearson’s correlation coefficient indicated a statistically significant linear relationship between test and retest results $r(10) = 0.94$ $p<0.001$. For these data, the Mean (SD) for the Test = 3.76 (0.38) and for Retest = 3.61 (0.52). The coefficient of stability statistic ($r = 0.94$) provided support for the argument that the TPACKBRU has a high level of test-retest reliability.

3.3.6. Internal Consistency

A convenience sample of 45 in-service Brunei teachers volunteered to answer TPACKBRU. Although convenience sampling is likely to lack representativeness, it is expedient, inexpensive to implement, and suitable for piloting a questionnaire (Bryman, 2008; Teddlie & Tashakkori, 2009). Given the purpose of the preliminary study was to develop TPACKBRU, and not to report findings representative of a teacher population, the researcher was satisfied the teacher selection procedure was appropriate.
Cronbach’s Alpha scores ranging from 0.60 for the content knowledge subscale to 0.87 for the technological content knowledge subscale (see Table 6), indicated that reliability was satisfactory for those subscales that included reference to technology in their items.

**Table 6. Analysis of pilot study questionnaire responses**

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Number of Items</th>
<th>Number of Completed Responses</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>CK</td>
<td>3</td>
<td>44</td>
<td>3.99</td>
<td>0.26</td>
<td>0.60</td>
</tr>
<tr>
<td>PK</td>
<td>7</td>
<td>40</td>
<td>3.76</td>
<td>0.14</td>
<td>0.81</td>
</tr>
<tr>
<td>PCK</td>
<td>4</td>
<td>41</td>
<td>3.75</td>
<td>0.14</td>
<td>0.74</td>
</tr>
<tr>
<td>TPCK</td>
<td>8</td>
<td>34</td>
<td>3.36</td>
<td>0.49</td>
<td>0.79</td>
</tr>
<tr>
<td>TK</td>
<td>6</td>
<td>41</td>
<td>3.28</td>
<td>0.35</td>
<td>0.83</td>
</tr>
<tr>
<td>TCK</td>
<td>3</td>
<td>38</td>
<td>3.06</td>
<td>0.10</td>
<td>0.87</td>
</tr>
<tr>
<td>TPK</td>
<td>5</td>
<td>35</td>
<td>2.97</td>
<td>0.33</td>
<td>0.81</td>
</tr>
</tbody>
</table>

The researcher, therefore, concluded that TPACKRU — in particular, the technology related subscales (TK, PCK, TPK and TPCK) — when combined with other indicators, might contribute to an understanding of the professional development needs of teachers in this study. In addition, he felt teachers’ perceptions of their TPACK might be a contributing factor that would help to explain why some teachers might adopt and participate in learning communities more successfully than others.

**3.4. Online Learning Community Development Indicator**

Ke and Hoadley (2009) suggested that online learning communities might best be evaluated by measuring clusters of indicators in an on-going meta-cognitive analysis. To this end the researcher developed a rubric, the Online Learning Community Development Indicator (OLCDI), presented in Table 7, was developed to determine the location of a learning community on a developmental continuum. The items in the OLCDI were derived from the research literature about communities of practice and online collaborative learning that has been summarised in chapter 2, and from initial analysis of the all communities at the end of the professional learning programme. The OLCDI was used to identify a single high performing OLC, and a single underperforming OLC. These two communities were examined closely in the next part of the study. The OLCDI was subsequently further refined following analysis of the two case studies.
Table 7. Online Learning Community Development Indicator (OLCDI)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>High performing community</th>
<th>Underperforming community</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Activity level</td>
<td>The community collectively demonstrates high levels of interaction by generating a high number of discussion posts and by engagement in a high number of other knowledge production activities.</td>
<td>Low levels of collective participation in knowledge production or community building activities.</td>
</tr>
<tr>
<td>2 Outliers</td>
<td>Interquartile range for posting frequency distributions is small – indicating all teachers contributed equally, and no outliers. Outliers are teachers that dominate knowledge production activities. Their presence is indicated by high levels of activity in knowledge building activities.</td>
<td>Large posting frequency interquartile range and/or presence of outliers.</td>
</tr>
<tr>
<td>3 Goal orientation</td>
<td>The community has collectively defined the learning goals it hopes to achieve.</td>
<td>Little or no evidence that learning was a driver for completing professional development activities. An alternative driver may</td>
</tr>
<tr>
<td>4 Relationships</td>
<td>Relationships of trust, respect, and challenge; effective disagreement resolution strategies</td>
<td>Relationships remain under developed, and/or the community has become divided</td>
</tr>
<tr>
<td>5 Community size</td>
<td>Four or more active community members</td>
<td>Three or fewer active community members</td>
</tr>
<tr>
<td>6 Community support</td>
<td>Community members actively support the sustainment and continuing development of their community</td>
<td>Little or no evidence of community building activities</td>
</tr>
<tr>
<td>7 Visibility</td>
<td>Community members are highly visible online, as indicated by web tracking statistics and in particular posting frequencies to discussions</td>
<td>Teachers are by and large infrequent contributors to online activities</td>
</tr>
<tr>
<td>8 Values</td>
<td>Teachers have shared values that support OLC goals</td>
<td>Teachers appear to have conflicting values</td>
</tr>
<tr>
<td>9 Intentionality</td>
<td>Focused conversations that addressed project protocol questions</td>
<td>Ad-hoc discussions mixed with focused discussions</td>
</tr>
<tr>
<td>10 Pre-training</td>
<td>All community members have prerequisite skills knowledge and dispositions required to participate in projects.</td>
<td>Community members do not have necessary skills and knowledge for participation in Projects</td>
</tr>
</tbody>
</table>

**Teacher Characteristics**

<p>| 11 Inquiry minded | Individuals are active in CPL project investigations that seek to solve teaching and learning problems | Limited or no support for learning investigations |
| 12 Collaborative learning skills | Individuals participate meaningfully in learning community activities | Little or no collective knowledge building capacity |
| 13 ICT | Individuals have access to, and the means to use ICTs for knowledge production | Only limited access to, and/or incorrect usage of ICTs |
| 14 Data wise | Individuals have the skills and knowledge to collect, process, and present data effectively | Little or no demonstrated use of statistics and/or poor classroom investigation design |</p>
<table>
<thead>
<tr>
<th></th>
<th>Learning Load</th>
<th></th>
<th>Online Learning Community Operational Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td><strong>Learning Load</strong></td>
<td></td>
<td><strong>Leadership style</strong></td>
</tr>
<tr>
<td></td>
<td>Individuals have germane cognitive load capacity available for online collaboration, in part because they had little in the way of pre-training required to prepare for participation in knowledge production activities</td>
<td></td>
<td>Consensus decision making, though possibly some organizing roles allocated to individuals as well</td>
</tr>
<tr>
<td></td>
<td>Individuals have insufficient germane cognitive load capacity and too much extraneous and intrinsic cognitive load.</td>
<td></td>
<td>Hierarchical leadership style and some delegation of roles</td>
</tr>
<tr>
<td>16</td>
<td><strong>Self-Management</strong></td>
<td></td>
<td><strong>Continuous improvement</strong></td>
</tr>
<tr>
<td></td>
<td>Individuals manage their own time properly so they are able to make timely contributions to community activities</td>
<td></td>
<td>OLC teachers adjusted procedures and protocols to enhance CPL performances</td>
</tr>
<tr>
<td></td>
<td>Individuals do not manage their commitments well, and cannot contribute reliably to community activities</td>
<td></td>
<td>OLC teachers failed to consider ways to improve their CPL performances</td>
</tr>
<tr>
<td>17</td>
<td><strong>Multiliteracies</strong></td>
<td></td>
<td><strong>Project management</strong></td>
</tr>
<tr>
<td></td>
<td>Sends, receives, and understands messages in a range of modalities; knows the features and constraints of different online communication tools</td>
<td></td>
<td>Managed time, activity scheduling, and assigning members to cooperative and collaborative activities as appropriate. Collected evidence of performance to inform future community design</td>
</tr>
<tr>
<td></td>
<td>Uses some online communication tools with limited success, tends to use familiar tools whether designed for purpose or not</td>
<td></td>
<td>No evidence of the use of project management strategies</td>
</tr>
</tbody>
</table>

A combination of discussion transcript analysis and web tracking statistics provided sufficient information to be able to make informed decisions about learning community learning performances. Each of these approaches is discussed in the following subsections, and is followed by a description of how the results from each approach might be weighted and combined.
3.5. Web Tracking Statistics and Discussion Transcript Analysis

It is helpful to know levels of engagement in discussions, and counting postings will indicate this (Salmon, 2005). However, high levels of engagement do not necessarily mean high levels of interaction between participants. Firstly, if community teachers respond to the group instead of to each other in project discussions, the number of community postings may be large while the interaction between teachers is at a low level. This is not to say counting is unimportant, as communities that contribute few postings most certainly will have a low number of interactions between teachers.

The reader is reminded that the processes and procedures a learning community might go through to complete an evidence-based professional learning project (project) are described in Appendix B and Appendix C. These learning communities did not necessarily have to proceed through the project completion guideline steps sequentially; they were able to revisit steps previously completed. The solutions to teaching problems addressed by teachers were expected to go through iterations, in much the same way solutions evolve in action research (Stringer, 2004).

In a typical problem solving process, a number of alternate solutions are suggested by members of a learning community. One alternate solution, which teachers believe has the best chance of success, is then implemented in a classroom setting and its effect evaluated. The results of evaluation revealed that the solution was not effective, was partially effective, or was very successful. The solution was then either abandoned or refined in a number of cycles until the solution development process failed to significantly further change the classroom effect. Key to this project development process was that the decision on whether to continue or abandon an alternate solution was based on analysis of evidence after classroom testing.

Underlying the project concept is the notion that professional learning takes place during learning community project activities, and that the project solution is of secondary importance. This is an important consideration as it means the outcomes of community activity systems may be measured in terms of new community knowledge, skills, and dispositions rather than focusing entirely on (possibly unachievable) short-term learning performance gains of students in classrooms.
Web tracking statistics do not indicate what participants actually said, and yet it is clearly important to be able to analyse the meaning of participant contributions. However it is problematic to establish the message participants were conveying as coding conversations for meaningfulness is difficult (Fahy, 2001; Garrison & Anderson, 2005; Gunawardena et al., 1997; Rourke, Garrison, Anderson, & Archer, 2005). However, if a very simple coding schema is used, it may be possible to quantify the extent to which a learning community is engaged in team building and knowledge building activities. Both knowledge building and team building postings may reasonably be expected to be present in the discussion transcripts of the project activities of successful communities.

3.6. Main Study: Phase One

3.6.1. Purpose of Phase One

The main purpose of Phase One was to identify two communities that had different online learning performance characteristics. This aim was achieved by analysing online activity web server logs, discussion transcripts, and content analysis of community performance reports and community investigation reports.

3.6.2. Main Study Phase One Data Collection Procedures

Data was captured from research participants whenever they used the online Moodle facility that was provided to community teachers. Moodle is a powerful and popular learning management system that is widely supported internationally and used locally in Brunei as well (Moroney, 2010).

Moodle was selected as a tool for teachers during this study because it provided all the facilities they might need to conduct OLC activities. The facilities available included, amongst others, a range of synchronous and asynchronous communication facilities, a wiki building facility, multimedia sharing facilities, file sharing facilities, statistics and web tracking facilities, facilities for keeping conversations private within communities, and the availability of transcripts for community meta-cognition activities. Essentially, Moodle was selected because, at that time, it was the only available single tool that offered the facilities with the required accessibility and functionality needed by teachers to complete OLC activities. A unique Moodle installation was created for this study that
allowed teachers to interact with their community anytime they had an Internet
connection.

By using Moodle, the researcher was able to capture a large amount of data automatically,
including (1) transcripts of online professional learning conversations, (2) uploaded
monthly reports, and (3) weblogs that provided data about interactivity between teachers
and levels of activity in online conversations. Additionally, all research participants
completed the TPACKBRU questionnaire that was developed in the preliminary study.
The purpose of analysis of professional learning conversations in Phase One was to
identify a single, high-performing OLC and a low-performing community for later
comparison in Phase Two of the main study.

The OLCNI was developed (see Table 7) to provide an indication of the extent to which
learning communities were successfully building collective professional knowledge.
Rubric item scores were based on analysis of transcripts of online conversations between
members of professional learning communities as well as web tracking statistics and an
analysis of end-of-month reports that each group produced.

3.7. Main study: Phase Two

The preliminary study was focused on the development of a rubric and questionnaire for
use in the main study that followed. The main study was, in turn, divided into a sequence
of three main activities:

(1) Collection of data from 47 in-service teachers over a period of seven months,

(2) Analysis of collected data to identify an advanced OLC and a contrasting
underperforming OLC, and

(3) Analysis of data from the advanced OLC data and the underperforming OLC to
determine an answer to the two research questions.

The remainder of this chapter presents a detailed account of the methods and procedures
used at each stage of the study. The following sections follow the same flow as the
research plan diagram presented in Figure 7.

The second strand of the study consisted of two in-depth case studies. Yin (2009)
suggested that case study designs are appropriate when researchers are seeking answers to
how and why questions, and when context is relevant to the phenomenon being studied (De Vaus, 1985b). De Vaus (1985b) recommended that a case study method is appropriate when research questions to be investigated involve the description and analysis of a complex phenomenon in its natural setting. Baxter and Jack (2008) further added that a case study design affords researchers the opportunity to look at a phenomenon from different theoretical perspectives using a variety of data sources:

...an approach to research that facilitates exploration of a phenomenon within its context using a variety of data sources. This ensures that the issue is not explored through one lens, but rather a variety of lenses which allows for multiple facets of the phenomenon to be revealed and understood. (Baxter & Jack, 2008, p. 544)

The in-depth study of two very different professional learning communities helped to identify the reasons why different communities developed the way they did. Thick descriptions (Lincoln & Guba, 1985) of community data were developed by analysing project discussion transcripts, OLC investigation reports, and community performance reports. Thick descriptions describe a phenomenon in enough detail that conclusions drawn in the research may be transferred to other times, places, people, and settings (Lincoln & Guba, 1985).

The constant comparative method (CPM) was used to analyse Moodle discussion transcripts and project reports (Braun & Clarke, 2006; Glaser & Strauss, 1967). The CPM focuses on identification of themes through open coding, axial coding, and selective coding in a search for emergent theory. Open coding involves identifying any and all codes and subcodes in the textual content being examined. During axial coding, the researcher seeks to identify relationships between codes that might lead to theory. The researcher then uses a selective coding process to identify a central theme and all related themes. This central theme is then compared and contrasted with existing theories about communities and online collaboration in educational settings to determine the extent to which thematic results are previously mentioned in the literature, contradict the literature, or are completely new to the literature. The qualitative research analysis tool called Atlas Ti (ver. 6) was used for qualitative analysis.
3.8. Unit of Analysis

The unit of analysis was a learning community of between three and six Year 7 science teachers. Teachers formed communities with the condition there be only one teacher from a school in any single OLC. Each participating school was asked to supply at least two teachers from their staff. Each teacher in the professional development programme was free to work with any teachers from other schools subject to the conditions that no two teachers from the same school should be in the same community, and that communities needed to have between three and six teachers.

The first condition, that schools have at least two research participants, was deemed to be necessary because it was felt it would be helpful for participant colleagues to be able to assist each other with their regular community research projects, even if they were in different communities. For example, teachers could help each other by conducting a lesson observation if a learning community project intervention called for that.

The second condition was deemed necessary for two reasons. Firstly, there were sixty Year 7 science teachers available in the initial research sample; therefore, to make a feasible number of community performance comparisons possible, it was necessary to restrict group size. Secondly, there is evidence large communities (bigger than 10 teachers) may not be useful for collective knowledge building. A smaller sized community allows for each member to have a voice, minimizes the number of messages teachers need to attend to, and increases the attention participants pay to individual messages (Foord & Haar, 2008).

3.9. Professional Development Programme

The professional development associated with this study is called the Technology Enabled Science Teacher Learning Environment Development (TestLed) programme. TestLed aims to move teachers away from being passive consumers of professional development content towards becoming active producers of professional knowledge. The programme is designed to support the requirements that teachers learn how to create, develop and sustain an online learning community. Throughout the programme teachers (1) participate in evidence-based professional learning conversations during which they investigate a teaching and learning problem that they want to solve; (2) refine digital age
skills, develop digital literacies, and gain new professional knowledge; (3) seek to learn how to be a better teacher; (4) develop meta-cognition skills; and (5) develop online social learning skills. The most important learning outcome of TestLed is that teachers learn how to create, develop and sustain their learning community.

Implicit in the above is that teachers in a TestLed programme engage in dual track professional learning strands: an investigation of a teaching and learning problem, and an investigation to determine how they might improve the capacity of their community to produce collective knowledge effectively.

During the teaching and learning strand of their programme teachers use the project completion guidelines in table 3 to guide them through a process to find answers to a teaching and learning problem they see value in solving.

In the second OLC activity strand, teachers use the questions in table 4 to guide them towards understanding how their OLC works. Once they have a view of what is happening in their OLC they will want to find ways to alter the procedures and practices of their community in ways that improve the capacity of the community to produce collective knowledge.

TestLed began with 8 face-to-face workshop sessions in combination with online activities. Workshops were held twice monthly for 4 months. The reason for the workshops was to provide support for teachers as they learned to develop their community, and to provide them with opportunities to network with teachers in other communities. This meant showing teachers how to use online collaborative learning tools, how to contribute to discussions that are designed to produce collective knowledge, how to manage time and assess progress during a project, how to process data, and how to evaluate their own community performances. It also involved orienting teachers towards the need to develop relationships of trust and challenge within their communities, and the need to be reflective about their own learning. learning communities completed five projects, each taking approximately one month to complete.

The researcher was the provider of the professional development that research participants received in this study. The research began after the conclusion of a professional development programme that began in January 2011 and ended in September 2011.
3.10. Variables

This section lists the independent and dependent variables integrated into the design of this study.

3.10.1. Independent Variables

- Gender
- Age
- Familiarity with communications technologies
- Collaborative professional learning experience
- Years of teaching

3.10.2. Dependent Variables

3.10.2.1. Web Tracking Statistics

- OLC Moodle activity frequency
- OLC teacher activity frequency

Web tracking statistics are descriptive statistics drawn from analysis of Moodle server log data. Web server logs record communication transcripts as well as data about the timing of communications, senders, and recipients.

3.10.2.2. Learning Community Activity System Analysis Variables

- Tools that teachers use to conduct online discussions and other OLC activities
- OLC member characteristics, such as values, motivations and previous experiences with technologies (subject node)
- OLC rules and learning culture characteristics developed by the OLC (rules node)
- OLC links with others outside their community and links with external activity systems (external environment)
- OLC Cooperation and Collaboration within a community
- OLC Object – the motivations to complete OLC activities
- OLC project outcomes – professional learning outcomes
- Tensions between nodes in a learning community activity system
- Tension between traditional professional development activities and online activities
- Tension between the activity system under investigation and external activity systems (that have different agendas).

Activity theory analysis variables are derived from the activity theory diagram shown in Figure 8. Activity theory analysis data is contained in community monthly reports, online discussions, and recorded online synchronous communication sessions.

![Figure 8. Annotated CHAT triangle diagram](image)

### 3.10.2.3. Community of Practice Stages of Development

Six community of practice developmental stages are described by Wenger et al. (2002).

- Identifying potential
- Coalescing
- Nurturing
- Maturing
• Stewardship
• Transformation.

3.10.2.4. Learning Community Collective Knowledge Building Characteristics

• An inquiring habit of mind
• Relationships of respect and challenge
• Relevant data

The above three conditions are necessary (but not sufficient) to support professional learning (Earl & Timperley, 2009a).

3.11. Data Collection

Each learning community conducted several evidence-based professional learning conversations (projects) over a period of seven months. Teachers were expected to take about one month to complete a project. Community teachers were expected to produce summary and reflective reports at the end of each project. Sources of data, therefore, were:

1. A report summarizing a science teaching investigation.
2. A report that summarises what teachers think about the effectiveness of their community, and how they might make their professional learning community become more effective and efficient at developing actionable knowledge about science teaching in Brunei.
3. Transcripts from online discussions.
4. Web server logs recorded the frequency and timing of online activities for each individual.

In addition, all participants were invited to complete the TPACKBRU questionnaire at the beginning of their professional development programme.

3.11.1. TPACKBRU Administration

The TPACKBRU questionnaire was administered in the first and last week of the seven-month programme.

3.11.2. Phase One Data Analysis

This section describes the different analysis techniques used to compare and contrast the ten professional learning communities.
3.11.3. Web Tracking Statistics

Results from analysis of Moodle server logs provided information about communication patterns within a learning community. The duration, timing, and location of teachers who went online were recorded in Moodle server logs. Additionally, the content of Moodle discussions and community communication patterns were also readily available for analysis.

3.11.4. Content Analysis

Data from all seven months of the study was used to describe how each community developed over time. The advanced-level learning community and underperforming learning communities were determined at the end of analysis of month seven data. These two communities were contrasted and compared using grounded theory techniques; that is to say, textual messages generated by each community were separated into meaningful units where a unit is an idea, observation, or thought. Textual messages were then placed in code families that grouped together messages related to a single theme. Ten main code clusters were used to categorize messages (see section 3.6.2 for descriptions), and within each code, family sub-themes were developed (inductively and deductively) in an iterative and cyclical process during and after initial and repeated reading of transcripts.

Participant contributions were thus gradually reorganized into a logical thematic taxonomy that could be collated and reported. Analysis of digital artefacts was carried out using the application software called Atlas Ti (version 6).

3.11.5. Grounded Theory Code Families

The following code families were generated for an Atlas Ti hermeneutic unit. The code families relate directly to the tensions described in cultural historical activity theory (Engeström, 1999a).

Subject codes – reflections made by community teachers about the makeup of their knowledge-building community.

Object codes – reflections made by community teachers about their own motivations for completing projects.

Tools codes – community member observations about the features and constraints of the digital communication tools they used to complete discussions about science teaching.
Division of labour codes – community member observations about vertical (hierarchical) and horizontal (cooperative) community relationships within their community.

Rules codes – community member observations about explicit and tacit rules and protocols developed by the community to help it function effectively.

Outcome codes – community member observations about the extent to which their group created new knowledge about science teaching they each could use to create better quality learning experiences for science students.

External activity systems codes – OLC member observations about the influence (positive and negative) of outside contributions from teachers of external activity systems.

Inter-node tension codes – community member comments about tensions between combinations of the CHAT framework nodes.

Motivation codes – community member reflections about the impact of external pressure to support agendas that are different to the science-teacher knowledge building agenda their community is committed to.

Inertia codes – community member reflections about the difficulties their community had adjusting to the adoption of new ways of engaging in professional development.

The results of content analysis were combined into group reports and sent to the members of respective learning communities to verify that the analysis reflected what research participants believed had happened.

3.12. Answering Research Questions

This section describes the methods employed to answer each of the research questions.

3.12.1. Research Question One

To what extent do the collaborative professional learning characteristics identified in community of practice and professional learning community literature apply to communities of learning in the online environment?

3.12.2. How Research Question One is answered

The characteristics of learning communities were determined by examining the artefacts produced by teachers when they completed projects, and the presentations they made when they shared their project findings with other learning communities. The artefacts
included transcripts of online discussions, the wikis teachers produced to represent their new collective professional knowledge, reports produced by each OLC each time they completed a project, and presentation files from their sharing sessions.

An indication of appropriate levels of knowledge building was indicated when community conversations could be classified as (1) constructive, (2) critical, (3) accumulative, and (4) motivational (Soller & Lesgold, 2007). Levels of cooperation and collaboration were

The community of practice stage was calculated for each community by identifying forum postings characteristic of communities at a particular CoP developmental stage.

3.12.3. Research Question Two

To what extent may web tracking statistics be used to locate an online, collaborative, professional learning community on a developmental trajectory?

3.12.4. How Research Question Two is answered

Web tracking data was downloaded from the Moodle web server logs. The data was analysed with SPSS and Excel to generate descriptive statistics, including charts (box whisker plots), measures of centrality and measures of dispersion.

Given initial indications that discussion post frequency distributions for learning communities might not be normally distributed (and instead were likely to have bimodal post frequency distributions), it was necessary to make a decision about whether to use parametric or non-parametric measures of dispersion and centrality. In the event that it was found that underlying distributions were not normally distributed (as expected) then the median and mode would be used as measures of centrality, and the interquartile range and range used to indicate dispersion.

In addition, it was possible that not all communications between teachers was captured in Moodle server logs, given that teachers might use Facebook and other social networking tools to talk to each other online.

The answer to question two was determined by comparing the inferences that might be made through analysis of Moodle server data with the results of in-depth content analysis of OLC conversation transcripts. If the quantitative analysis results matched qualitative
analysis results then this would indicate that web tracking statistics might be used to locate a learning community on a developmental trajectory.

3.13. Phase Two – Data Analysis

The second part of the study consisted of two in-depth case studies. The digital artefacts of advanced and underperforming learning communities were analysed and contrasted. Close examination of the rich data sets generated by these two different learning communities were sufficient to support a search for answers to the research questions. In other words, the data was such that it could be considered inferentially in ways that developed tentative explanations that went beyond description.

Whereas the multiple case study research highlighted differences and similarities between and within learning communities, the in-depth study of two very different communities highlighted reasons why different communities developed the way they did. Yin (2009) suggested that case study designs are appropriate when researchers are seeking answers to how and why questions, and when context is relevant to the phenomenon being studied.

3.14. Ethical Considerations

Ethics approval was obtained from the University of Auckland Human Participants Ethics Committee. This section begins with an outline of traditional social research ethical issues considered in the current research project, and then describes additional considerations (Section 3.11.6) taken into account when the researcher used online data collection techniques.

3.14.1. Traditional Social Research Ethical Considerations

Social research responsibilities towards participants include the issues of (1) voluntary participation, (2) informed consent, (3) no harm, (4) confidentiality and anonymity, and (5) privacy (Bryman, 2008; De Vaus, 1985a; Social Research Association, 2003). Each of these considerations is individually discussed in the following sections.

3.14.2. Voluntary Participation

Participants were not required to respond to surveys or take part in other activities that were not a part of their normal professional development programme. Furthermore, the
choice to participate or not participate in no way influenced work conditions and continuing employment opportunities.

With voluntary participation in surveys incorporated into this study, it was necessary to consider the significance of the impact of non-participation on the quality of data collected. If a number of participants chose not to participate, this would have called into question the extent to which the data collected was representative of the views of teachers in a more general setting. Therefore, every effort was made to ensure there was participant buy-in. Several strategies were used to encourage participation; these included (1) dissemination of information about the importance of the research, and the regular reporting of research results back to participants; (2) reinforcing the idea that the research was participatory rather than something imposed on participants from outside; (3) collecting data effectively, efficiently, and in a timely manner so as to minimise the time participants were required to spend contributing research data; and (5) reinforcing the fact that the group, and not the individual, was the unit of analysis for this study.

3.14.3. Informed Consent

Participants were informed about the research before having to make a decision regarding the extent of their participation. They were provided with (1) an outline of the purpose of the study, (2) a timeline for research activities, (3) a description of the likely benefits of the study, (4) an offer to answer questions they may have had about the study, (5) a statement about voluntary participation, (6) the identity of the researcher and the body supporting the research, and (7) information about the way in which the results of the study would be presented and used (De Vaus, 1985a). A matter of primary concern was the protection of participants to ensure they were in no way harmed as a result of participation in the research.

The survey used in this study did not include any questions that might cause embarrassment or harm. While it is true that completing the surveys did take respondents some time, the results were made available for teachers to use as a resource to help them make informed decisions about how to proceed with their professional development. Additionally, surveys were completed online in confidence, and there was no opportunity for people other than the researcher to see completed responses.
3.14.4. Confidentiality and Anonymity

All contributions made by research participants were held in strict confidence – not only because it was ethically necessary to do so, but also to ensure the trust participants had in the researcher was not damaged in any way that would lead to guarded (biased) responses rather than full and open disclosure.

The researcher could not identify individual respondents in the study. The online survey tool (LimeSurvey) has facilities that guarantee there is no link between responses received and e-mail addresses of participants.

The researcher had and will continue to have complete and sole control of all data. Data collected online was loaded into a private network server to which access was strictly controlled. Other digital data was stored in encrypted form.

3.14.5. Privacy

Privacy extended beyond the principles of confidentiality and voluntary participation, and included the right of individuals to be free from intrusion (De Vaus, 1985a). Therefore, participants were only asked to respond to questions that related directly to the research aims of the study.

3.14.6. Ethical Considerations of Online Data Collection

There is an argument that as long as participants have been informed they are making contributions to a public space when they go online, there is less obligation on the part of researchers to “protect the anonymity of individuals using the venue, or to seek their informed consent” (Bryman, 2008, p. 654). However, this view is not universal, and it is not one supported by this researcher. The next few paragraphs will outline why the public space argument falls short of what is required for potential participants to be able to make an informed consent decision about contributing to research.

It is not a question of research participants having much to say about whether they are willing to provide data when they go online — they will be visible each time they connect to a Moodle server. The question, therefore, is not if data should be collected, but what to do with data that will inevitably end up in digital log files of an Internet web server. Is it reasonable (ethical) to make use of the data many participants are unaware they are contributing? Even when participants are informed about public space contributions, is it
reasonable to expect that all participants will fully understand the implications of what
this means? In this study, it was decided that it was necessary to go beyond informed
consent, and that the researcher would be guided by acceptable practice policies to
facilitate protection of online research participants. This meant ensuring participants
received the guidance and support they needed to be able to safely participate online; this
was achieved through the development of participant knowledge and skills so they could
engage online in an informed way.

Online data may be captured in both planned and unplanned ways. Participants contribute
in a planned way when they (1) complete online surveys, (2) join in online forum
discussions (it should be noted that, whether they contribute or not, web logs record their
IP address, access time, and duration, as well as any pages they visited), (3) participate in
synchronous online chat sessions, (4) contribute to personal weblogs, (5) contribute to a
wiki, and (5) contribute artefacts to the knowledge base of their online community of
practice. Each online activity generates artefacts, some of which are recognised as such,
while others are not. When a participant edits a wiki page, they know they are
contributing to something that is in the public domain.

3.15. Summary

This chapter presented the methodology used in this study. It focused on the
development of instruments to be used in a main study and identified the use of the
CHAT framework as an analytical lens for analysis of learning communities. Web
tracking analysis was briefly introduced, as was the use of a case study methodology that
was used to uncover new theory about how learning communities are created and
develop.
Chapter 4. Digital Tools and Techniques Used in the Study

The purpose of this chapter is to describe the software tools the researcher used in this study. This chapter is divided into three sections. The first section describes the learning management system, Moodle, used to gather, analyse, and export data and results. The second section describes the use of the questionnaire software. The last section describes the use of Atlas Ti ver. 6 for analysis of community reports, presentations and project transcripts.

4.1. Moodle

Moodle is a learning management system that allows users to participate in online discussions, build wikis, and chat online (Dougimas & Taylor, 2002; Moroney, 2010; University of Wollongong, 2011). The Moodle environment was configured for this research so each OLC could operate independently of other learning communities. The use of Moodle in this research was an intentional design characteristic to ensure that as much as possible project communication occurred online in this environment to take advantage of the Moodle server logs. If alternatives to Moodle (Facebook, SMS, etc.) were used for community teacher communication, it would not be possible to access the discussion transcript data or web log data required for analysis of community performances.

The use of Moodle in this study enabled the researcher to automatically capture data when community teachers participated in project activities; this included (1) transcripts of online discussions, (2) uploaded project investigation reports and community performance reports, and (3) weblogs that provided data about the online activities in which individual teachers participated.

4.1.1. Capturing Moodle Data

Moodle server logs captured data about online project activities; for example, when teachers went online, a record was created that included the timing, duration, quantity, and content of online communications within the Moodle environment. A non-exhaustive list of such activities is shown in Appendix H. The activities of most importance, from the research perspective of this author, are the communication activities teachers participated in that helped to generate community collective knowledge. Knowledge building
activities included online chat room activities, online discussions, and the development of OLC wikis.

4.1.2. Processing Moodle Server Data

Several types of data were collected from Moodle server logs. Firstly, the transcripts of community teacher discussions were downloaded and saved as offline web pages. These discussion transcripts were converted into either PDF files or Microsoft Word documents and then exported into Atlas Ti ver. 6 (Atlas) for thematic analysis or analysis using the constant comparative method (Braun & Clarke, 2006). Secondly, community teachers completed community performance reports and community investigation reports in either Microsoft Word or PDF format, and uploaded them into Moodle. These reports were then downloaded from Moodle and stored offline for later content analysis. Thirdly, Moodle server activity reports were downloaded from Moodle (as Excel files). Moodle activity data was then investigated using Excel descriptive statistical functions to determine the characteristics of individual community teachers and the levels of activity of communities as a whole. Results of the Excel analysis generated individual Moodle activity summaries for each community teacher in the study. Individual results, like those outlined in Table 8 below, could then be compared with the results of other individuals in a learning community. In addition, individual results could be combined to develop an activity profile for a whole OLC. Profiles for each community could then be compared in order to rank communities according to activity levels.

<table>
<thead>
<tr>
<th>Moodle Activity</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>35</td>
</tr>
<tr>
<td>Chat view</td>
<td>9</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>106</td>
</tr>
<tr>
<td>Forum add post</td>
<td>87</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>443</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>125</td>
</tr>
<tr>
<td>Wiki view</td>
<td>620</td>
</tr>
<tr>
<td>Wiki view all</td>
<td>11</td>
</tr>
</tbody>
</table>

Excel was used to calculate descriptive statistics of community Moodle activity frequency distributions; statistics include the community distribution median, lower quartile, upper
quartile, interquartile range, and minimum and maximum Moodle activity frequencies for each OLC.

Data captured in Excel format was loaded directly into SPSS version 19 for further quantitative analysis (Carver & Nash, 2012). In this study, box whisker plots were produced with SPSS to compare community Moodle activity frequency distributions.

4.2. LimeSurvey Online Questionnaire Software

LimeSurvey is web-based software that may be used to create, administer, and analyse online questionnaires. LimeSurvey was used to administer the TPACKBRU questionnaire developed in the first phase of this study.

LimeSurvey was chosen for four main reasons. Firstly, the use of an online questionnaire avoids the possibility of transcription errors by capturing questionnaire responses digitally. Secondly, LimeSurvey has export features that allow quantitative response data to be exported to SPSS, and qualitative (open-ended question responses) to be exported to Excel for later use with qualitative analysis using Atlas Ti. Therefore, the researcher was able to eliminate the possibility of errors being made during any formatting of data files before they could be used with analysis packages. Thirdly, when teachers are asked to participate in an online survey, the delivery of questions may be more consistent for participants than if they are given a pencil and paper questionnaire (Dillman, Smyth, & Christian, 2009). Finally, this questionnaire was designed with question-skipping logic, something that is difficult to replicate in pencil and paper mode. Question skipping was desirable, as some demographic questions such as “Do you use your laptop to plan lessons?” were only relevant to teachers who had earlier indicated they owned one.

Administration of an online questionnaire is not without its problems, many of which are described by Dillman et al. (2009). For example, placing a questionnaire online may introduce coverage errors; this might occur when community teachers find they are not able to go online to answer the questionnaire, so responses only come from a selection of teachers. Nonresponse errors are also possible; these occur when teachers who are of central importance to the study do not answer the questionnaire. There can be any number of reasons for nonresponse errors; for example, teachers may simply have forgotten to respond, lost track of their invitation e-mail, or simply not looked at their e-mail until after the questionnaire closing date. With the above implementation issues in mind, the
researcher adopted the *Tailored Design Method* (TDM), as presented by Dillman et al., (2009), to guide the TPACKBRU administration strategy.

The TDM is essentially a set of guidelines that helps to mitigate complexity and maximize participant response rates. Some of the most important TDM guidelines are (1) the use of personalized contacts to respondents; (2) acknowledgement of participation with an appreciation letter; (3) the careful timing of contacts with our sample population teachers; (4) the use of short, simple, and to the point e-mail contacts; (5) the follow-up of contacts when the researcher suspected the questionnaire e-mails had been flagged as spam; (6) clear and simple instructions about how to access the questionnaire; (7) assignment of unique tokens to respondents to enable easy identification of communications with particular sample teachers, while maintaining a level of participant anonymity; (8) token use to strictly control access to our questionnaire; and (9) active monitoring of responses to establish early indications of response rates (Dillman et al., 2009).

LimeSurvey has all the features required to administer a questionnaire using the TDM. Participants received a questionnaire hyperlink in their e-mail and simply clicked on the link to begin the survey. Tokens were automatically generated for each sample member to ensure participant privacy; e-mail contact letters were automatically personalized and automatically sent when sample teachers completed the questionnaire. Reminder letters were automatically generated every three days to remind teachers when they had not completed TPACKBRU.

### 4.3. Content Analysis with Atlas Ti (ver. 6)

The software package called Atlas Ti was used to conduct analysis of textual artefacts produced by community teachers. Atlas Ti is a feature-rich application that helps the user to focus on analysis rather than on the time-consuming manual coding activities necessary to complete when textual analysis is carried out manually.

The data for each TPACKBRU open-ended question response was exported directly from LimeSurvey to a Microsoft Excel file. The answer text in that file was then copied into a Microsoft Word document where it was formatted for readability by removing hyperlinks and table formatting. This Word document was then imported into an Atlas Ti project for qualitative analysis.
Reports were in Microsoft Word format and able to be imported directly into an Atlas Ti heuristic unit for analysis. Moodle discussion transcript web pages were converted into Microsoft Word documents before being imported into Atlas Ti for CCM analysis.

4.4. Summary

This chapter has showcased the major software tools used in this study. Moodle, NodeXL, and LimeSurvey are open source tools that are effective for capturing and processing data, and exporting results to other applications. Atlas Ti is an excellent software tool for qualitative analysis of open-ended question responses and project discussion transcripts. All data was captured digitally in this study, and, furthermore, no data needed to be transformed manually before being exported for use with alternate software tools. Therefore, by using the powerful analytical tools described in this chapter, the researcher took a major step to ensure he was able to focus on the analysis of a large quantity of data rather than spending a large amount of time manipulating data manually.
Chapter 5. TPACKBRU Questionnaire Response Analysis

5.1. Introduction

This chapter presents the results of analysis of TPACKBRU questionnaire responses. The purpose of this chapter is to provide a rich description of the research participants in this study, and the context within which they work.

5.2. TPACKBRU Questionnaire Administration

The TPACKBRU questionnaire contains sections for demographics, TPACK items, and free response items. View Appendix E to see a representation of the TPACKBRU online questionnaire. TPACKBRU was administered twice, once in February and again in September. The February administration of the questionnaire is called TPACKBRU-Feb, and the September administration is called TPACKBRU-Sep. The number of responses to TPACKBRU-Feb was 53 and the number that responded to TPACKBRU-Sep was 33.

5.2.1. Demographic Information

The following paragraphs provide descriptive statistics about independent variables used in this study. Data was collected about teacher age, gender, familiarity with ICTs (at school and outside the workplace), and experiences learning professionally with other teachers.

5.2.2. Age and Gender Demographics

The box whisker plot presented in Figure 9 indicates that the median age of research participants was 29 years old in February 2011. The lower and upper quartiles were 27 and 31 years respectively. Two teachers were older than the rest of the group (38 years and 54 years); and the youngest teacher was 24 years old.
All except two teacher research participants were young and relatively new to teaching. The median number of years of teaching experience was five years and the interquartile range was from two to seven years of teaching. TPACK-Feb was answered by 47 female and 15 male teachers.

5.2.3. Access to a Laptop

In Feb 2011, 48 (91%) teachers owned laptops and three (6%) did not; while two (3%) did not answer. Of those who own laptops, 46 (96%) make daily use of them for schoolwork (two teachers did not answer the question). Teachers indicated, for example, that they used their laptops for lesson planning and recording student marks.

5.2.4. Access to the Internet

Access to the Internet was crucial for teachers in this study, for when they could not go online they were unable to participate in online professional learning community activities. Teachers completed most community activities from home. Results indicate that some teachers used the Internet provided by their school, but given the lack of consistent access and the busy teaching schedules the teachers had, it appears they did not have much quality time in which to focus on their professional development.

While 41 (77%) have Internet access at home, eight (15%) said they did not; the remaining four (8%) teachers did not answer this question. Of those eight teachers, without an Internet connection at home, four belong to the community called TT (see Table 9. Internet access barriers). As mentioned earlier, when teachers do not have the
means to connect online, there is a serious impact on the cohesion of their OLC. For example, if one member of a learning community of four teachers is not able to join community online discussions, the community will have lost 25 percent of the knowledge and experience that might otherwise be brought to bear on community challenges. Additionally, as is shown to be the case many times in this report, communities with three or fewer active teachers simply did not coalesce into a working team focused on collective knowledge building.

**Table 9. Internet access barriers**

<table>
<thead>
<tr>
<th>Group ID</th>
<th>Group teachers</th>
<th>No Internet at home</th>
<th>Do not use Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC</td>
<td>IC-1, IC-2, IC-3, IC-4 (4 teachers)</td>
<td></td>
<td>IC-2</td>
</tr>
<tr>
<td>MA</td>
<td>MA-1, MA-2, MA-3, MA-4 (4 teachers)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ME</td>
<td>ME-1, ME-2, ME-3 (3 teachers)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD</td>
<td>PD-1, PD-2, PD-3, PD-4, PD-5 (5 teachers)</td>
<td>TT-1, TT-2, TT-3, TT-4</td>
<td>TT-1, TT-2, TT-3, TT-4</td>
</tr>
<tr>
<td>SA</td>
<td>SA-1, SA-2, SA-3, SA-4, SA-5 (5 teachers)</td>
<td>SA-5</td>
<td></td>
</tr>
<tr>
<td>FA</td>
<td>FA-1, FA-2, FA-3 (3 teachers)</td>
<td></td>
<td>FA-1, FA-2, FA-3</td>
</tr>
<tr>
<td>JE</td>
<td>JE-1, JE-2, JE-3, JE-4, JE-5, JE-6 (6 teachers)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LU</td>
<td>LU-1, LU-2, LU-3, LU-4, LU-5, LU-6 (6 teachers)</td>
<td>LU-1</td>
<td>LU-1</td>
</tr>
</tbody>
</table>

89
5.2.5. Likert Scale Item Analysis

Likert scale item data was evaluated using SPSS (version 19). Table 10 lists the means and standard deviations for each of the analysed questionnaire subscales in rank order. Results show, as expected, that teachers were confident they had good subject content knowledge (M[3.94], SD[0.76]) pedagogical knowledge (M[3.57], SD [0.97]), and pedagogical content knowledge (M[3.44], SD[0.95]). These teachers are experienced in-service teachers who know their subject well.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CK</td>
<td>3.94</td>
<td>0.76</td>
</tr>
<tr>
<td>PK</td>
<td>3.57</td>
<td>0.97</td>
</tr>
<tr>
<td>PCK</td>
<td>3.44</td>
<td>0.95</td>
</tr>
<tr>
<td>TPCK</td>
<td>2.99</td>
<td>1.03</td>
</tr>
<tr>
<td>TCK</td>
<td>2.99</td>
<td>1.11</td>
</tr>
<tr>
<td>TK</td>
<td>2.83</td>
<td>1.15</td>
</tr>
<tr>
<td>TPK</td>
<td>2.57</td>
<td>1.14</td>
</tr>
</tbody>
</table>

The results of content analysis of background information for teachers revealed what they thought about teaching, and also their feelings about the extent to which they were comfortable with technologies. Firstly, most questionnaire respondents were satisfied with their level of understanding of teaching content knowledge as it applies to teaching Year 7 science in Brunei schools. Table 11 shows that 81.13 percent of respondents agreed or strongly agreed that they were familiar with the language, notation, and procedures of high school science. This finding seemed unexpectedly low given that all research respondents were trained teachers. However, in Brunei, science teachers often begin by teaching at Year 7, and then progress to higher-level classes in the years that follow. Given this is the case, a new teacher may well be unfamiliar with the content of Year eight and Year nine science.
Table 11. CK subscale item statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with the language, notation, and procedures that are</td>
<td>Strongly disagree (SD) 0 0.00%</td>
</tr>
<tr>
<td>used in high school science.</td>
<td>Disagree (D) 1 1.89%</td>
</tr>
<tr>
<td></td>
<td>Neither agree or disagree (N) 9 16.98%</td>
</tr>
<tr>
<td></td>
<td>Agree (A) 35 66.04%</td>
</tr>
<tr>
<td></td>
<td>Strongly agree (SA) 8 15.09%</td>
</tr>
<tr>
<td></td>
<td>No answer 0 0.00%</td>
</tr>
</tbody>
</table>

Although teachers were confident they knew their subject area, they were slightly less certain about how to choose pedagogical approaches to maximize student learning. Table 12 shows that only 64.15 percent of questionnaire respondents were positive about being able to adjust a teaching strategy to improve student learning outcomes. This may well be because they were under pressure to meet syllabus completion deadlines and chose procedural compliance ahead of the use of effective but more time consuming approaches to learning. Teachers, therefore, only infrequently mentioned modes of teaching other than high velocity transmission mode teaching using PowerPoint and instructional videos downloaded from the Internet. It is possible that teachers are simply not given the opportunity to deviate from prescribed teaching methods – either because of a school culture that inhibits variation in teaching style from a prescribed norm, or the need to use pedagogical approaches that require minimal time to complete.

Table 12. PK subscale item statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can adapt my teaching based upon what my students currently</td>
<td>Strongly disagree (SD) 0 0.00%</td>
</tr>
<tr>
<td>understand or do not understand.</td>
<td>Disagree (D) 3 5.66%</td>
</tr>
<tr>
<td></td>
<td>Neither agree or disagree (N) 16 30.19%</td>
</tr>
<tr>
<td></td>
<td>Agree (A) 27 50.94%</td>
</tr>
<tr>
<td></td>
<td>Strongly agree (SA) 4 7.55%</td>
</tr>
<tr>
<td></td>
<td>No answer 3 5.66%</td>
</tr>
</tbody>
</table>

Table 13 shows that only 30 percent of respondents indicated they may have difficulty completing the Year 7 science syllabus on time, and only two of 53 questionnaire
respondents strongly believed they had a way to successfully get through the science syllabus. The pressure on teachers to complete the syllabus on time may influence their choices of what they wish to do to complete the syllabus. Under such circumstances, teachers may wish to teach to the exam and, therefore, use teacher-centred approaches to classroom practice that transmit syllabus content quickly.

Table 13. PCK subscale item statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I know how to develop efficient lessons that will help to ensure that all topics are completed in the required time.</td>
<td>Strongly disagree (SD) 0 0.00%</td>
</tr>
<tr>
<td></td>
<td>Disagree (D) 15 28.30%</td>
</tr>
<tr>
<td></td>
<td>Neither agree or disagree (N) 17 32.08%</td>
</tr>
<tr>
<td></td>
<td>Agree (A) 17 32.08%</td>
</tr>
<tr>
<td></td>
<td>Strongly agree (SA) 2 3.77%</td>
</tr>
<tr>
<td></td>
<td>No answer 2 3.77%</td>
</tr>
</tbody>
</table>

Table 14 shows that 18.9 percent of teachers thought they would use technology for student-centred learning; a further 77.4 percent were less optimistic about being able to do this; and 35.8 percent of teachers either disagreed or strongly disagreed with the statement.

Table 14. TPCK subscale item statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can create technology-enhanced lessons that are student-centred.</td>
<td>Strongly disagree (SD) 6 11.32%</td>
</tr>
<tr>
<td></td>
<td>Disagree (D) 13 24.53%</td>
</tr>
<tr>
<td></td>
<td>Neither agree or disagree (N) 22 41.51%</td>
</tr>
<tr>
<td></td>
<td>Agree (A) 9 16.98%</td>
</tr>
<tr>
<td></td>
<td>Strongly agree (SA) 1 1.89%</td>
</tr>
<tr>
<td></td>
<td>No answer 2 3.77%</td>
</tr>
</tbody>
</table>

The results shown in Table 15 indicate that 39.6 percent of participants believe they can prepare lessons that include a technology component. However, this does not mean lessons go beyond the use of presentation software and the use of digital projectors. Responses to other TPCK questions suggest that teachers use technology for presentation purposes, with little evidence of use for anything else.
Table 15. TPCK subscale item statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can choose a combination of pedagogy and technology to match the</td>
<td>Strongly disagree (SD) 1 1.89%</td>
</tr>
<tr>
<td>content I want to teach.</td>
<td>Disagree (D) 6 11.32%</td>
</tr>
<tr>
<td></td>
<td>Neither agree or disagree (N) 24 45.28%</td>
</tr>
<tr>
<td></td>
<td>Agree (A) 19 35.85%</td>
</tr>
<tr>
<td></td>
<td>Strongly agree (SA) 2 3.77%</td>
</tr>
<tr>
<td></td>
<td>No answer 1 1.89%</td>
</tr>
</tbody>
</table>

Table 16 shows that more than half the teachers surveyed (83%) report they do not have access to a range of different technologies in their school. Therefore, it is likely most teachers do not have much experience using technologies for anything other than to support transmission mode teaching. This means that while teachers may be familiar with PowerPoint and the use of the Internet as a source of material for lessons, they may have no experience with any software that might be used to support collaborative online learning.

Table 16. TK subscale item statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have had sufficient opportunities to work with different digital</td>
<td>Strongly disagree (SD) 5 9.43%</td>
</tr>
<tr>
<td>technologies.</td>
<td>Disagree (D) 19 35.85%</td>
</tr>
<tr>
<td></td>
<td>Neither agree or disagree (N) 20 37.74%</td>
</tr>
<tr>
<td></td>
<td>Agree (A) 8 15.09%</td>
</tr>
<tr>
<td></td>
<td>Strongly agree (SA) 0 0.00%</td>
</tr>
<tr>
<td></td>
<td>No answer 1 1.89%</td>
</tr>
</tbody>
</table>

Table 17 indicates that teachers were not sure about how to use technology to support online collaboration. This is a significant result because it can be interpreted to show that most teachers are unfamiliar with the use of technology to support collaborative work; therefore, it is possible that teachers are also unfamiliar with the use of technologies to support communities.

Table 17. Subscale item statistics
Table 18 indicates most teachers do not believe they are able to create opportunities for their students to experience individualized learning. Response to this item may be explained by three reasons or a combination thereof. Teachers may not be able to create individualized lessons because they have neither access to a reliable and accessible technology platform, the time to create resources, the software to support development, nor access to subject matter experts and others required for quality assurance purposes (Moroney, 2006).

Table 18. TPK subscale item statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can create opportunities for students to use digital technology for individualized learning.</td>
<td>Strongly disagree (SD) 6 11.32%</td>
</tr>
<tr>
<td></td>
<td>Disagree (D) 13 24.53%</td>
</tr>
<tr>
<td></td>
<td>Neither agree or disagree (N) 21 39.62%</td>
</tr>
<tr>
<td></td>
<td>Agree (A) 11 20.75%</td>
</tr>
<tr>
<td></td>
<td>Strongly agree (SA) 1 1.89%</td>
</tr>
<tr>
<td></td>
<td>No answer 1 1.89%</td>
</tr>
</tbody>
</table>

The average responses to TPCK, TCK, TK, and TPK subscale questions were less positive than those for CK, PK, and PCK. This indicates teachers were confident about their knowledge of traditional teaching (without technology), and less confident they could sustain a technology-enhanced learning environment.

5.2.6. Open-ended Question Responses

Research participants were invited to answer six open-ended questions (see Appendix 1 for a listing of the TPACKBRU questionnaire). Analysis of the responses to these questions helps to explain the extent to which some teachers may adopt communities for professional development more easily than others do.
Responses to open-ended questions were mostly unguarded and informative, as shown in the open-ended responses submitted by the teacher LU-6 (see Figure 10). Analysis of LU-6 responses showed little variation between answers to both sessions. Open-ended question responses were coded into the following families to produce an explanation of the views of teachers:

1. **Teacher use of online facilities** includes the use of online content sources for professional development, and the use of social networking facilities for sharing information.

2. **Teacher use of technologies** includes tools used for productivity and communication. This family of codes provides an indication of the degree to which teachers might be multiliterate.

3. **Professional development learning strategies and experiences** includes descriptions of the types of professional development teachers experienced.

4. **Collaborative learning experiences** includes any teacher experiences of learning with other teachers, whether ad-hoc or formally organised through professional development courses.

**5.2.7. Teacher Use of Online Tools for Professional Learning**

Brunei teachers make extensive use of Facebook and other technologies to communicate professionally with each other. E-mail and Moodle are also mentioned, but less often. Facebook is almost exclusively used in an ad-hoc way rather than for organised social learning. There was only one response to indicate that teachers have formally organized the way they use Facebook so that it might be used for professional learning:

**TPACKBRU-Sep (JE-6)**

“Our department also have a group form in the Facebook which we usually used to remind important things and discussing stuff.”

It is also unclear from teacher responses how much of their Facebook usage involved sharing information and teaching resources as opposed to using Facebook as a forum for in-depth discussion of teaching and learning problems that might advance the professional knowledge of teachers. As the quote above suggests, while Facebook may often be used for sharing information about procedural matters such as deadlines for events and department meeting notifications, this online communication medium appears to be largely limited to sharing information as the following typical comment suggests:
“Facebook and our school have made website where teacher can upload their notes, exercises or to inform any update to their student.”

It is clear teachers use Facebook for professional communication because they are familiar with it and are already accustomed to using it for social networking;

Since I’m updating my Facebook twice a week, therefore when I need to share anything with my colleague or friends usually I inbox them first.

5.2.8. Teacher Use of Technologies

Brunei teachers make use of laptops and data projectors for teaching. They also make frequent use of mobile technologies that permit access to the Internet. G3 mobile phones (Apple and Android) are frequently used and often mentioned in the same sentence as Facebook. This quotation is representative of a number of comments indicating teachers use mobile devices to connect to the Internet.

“Anything that enables me to connect to the Internet such as mobile phones, laptops and my PSP.”

Mobile phone penetration in Brunei is very high — with most people owning more than one. Mobile phones are used for regular texting and talking, but they are also used extensively for connecting to the Internet. Sometimes, teachers use their mobile phone as an access point so they can connect to the Internet on their laptop (tethering). Other times, such as when using Facebook, teachers indicated they used their phones independently of any other equipment. Other mobile devices were mentioned, including tablets, but teachers did not say what they used those digital tools for.

The widespread use of mobile technologies may be due to challenges teachers face in schools where wireless Internet access is limited — if available at all. In addition to not having wireless access, YouTube and Facebook are not available via school network systems.

“Internet connection is a problem. We hardly can access to the Internet...”
Therefore, if teachers are to communicate with each other online, and they wish to use Facebook to do this, they have little option other than to use their own mobile devices and mobile network accounts to access the Internet.

5.2.9. Professional Development Strategies and Experiences

There does appear to be a gap between required and actual professional development available to teachers. The model of professional development in Brunei is called the *train the trainers* method. One teacher from a school is asked to go to a centralized workshop where she learns new skills and knowledge that she then transfers to her colleagues when she goes back to her school.

*TPACKBRU-Feb (LU-6)*

“*most of the time its sync[sic] or swim, trial or error but willing to learn from friends if they know the stuffs better. have not attend much course on digital technologies...”*

Centralised workshops are known to be a largely ineffective way to attain professional learning goals (Guskey, 2000; Loucks-Horsley et al., 2003; Timperley et al., 2007). Experiences in Brunei are similar to those reported in other countries where centralized training, short duration workshops, and the *train the trainer* model are often criticized for being insufficient to help teachers make the changes in practice that lead to improvements in student learning.

5.2.10. Collaborative Learning Experiences

Collaboration is usually limited to sharing resources, sharing practices, and division of labour to complete work, and for seeking helpful information. The quotation below shows how this teacher assisted in building a content knowledge question bank with other teachers — and how she sought out advice on problems she was facing by asking her colleagues.

*TPACKBRU-Sep (PD-4)*

“*have collaborate in some of the activities especially on doing the questions bank.. and discussing some of the solutions on facing some of the problems”*

Although professional development is provided for teachers in Brunei, at this time there is evidence it is insufficient to meet their needs; teachers mostly learn from friends.
sometime I learn by trial and error and most of the time by observation... I watch how people use their softwares and i try to figure out how they did it, if i failed figuring out.. i usually ask them myself.... not so much in reading manual though.. it makes me sleep, i’m more of a hands-on learner

Teachers do, therefore, collaborate to learn; however, the extent to which this approach is sufficient to develop teachers professionally is open to debate. The clear risk of following such an ad-hoc approach to professional development is that existing entrenched practices may be promoted because inexperienced teachers defer to more experienced teachers for advice.
Figure 10. LU-6 TPACKBRU open-ended question responses

The qualitative analysis tool called Atlas Ti (ver. 6) was used to support analysis of the open-ended question responses to TPACK-Feb and TPACK-Sep.
A total of 65 code families were identified during analysis of TPACK-Feb and TPACK-Sep open-ended question responses. Both the groundedness and density of codes were calculated to identify the themes of greatest significance to teachers. The groundedness of a code is the number of times the code appears in the TPACK questionnaire responses. For example, the groundedness of the term laptop is 131, meaning that 131 sentences contained the term laptop. The code density for laptop is 13, meaning that laptops were linked to 13 other codes. For example, teachers use laptops for PowerPoint presentations using a data projector. In this example, content analysis supports an argument that teachers use laptops and portable data projectors (two other codes) to deliver presentations during lessons. Table 19 lists the top 10 themes identified in TPACKBRU questionnaire open-ended responses.

Table 19. Top 10 code families by groundedness and density

<table>
<thead>
<tr>
<th>Theme</th>
<th>Groundedness</th>
<th>Density</th>
<th>Sample comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laptop</td>
<td>131</td>
<td>13</td>
<td>“I usually use laptops and projectors for teaching as I use power point presentations for my classes.”</td>
</tr>
<tr>
<td>Data projector</td>
<td>127</td>
<td>20</td>
<td>Usually I used projector and also laptop in my presentation especially when I want to show the diagrams which I cannot draw on the whiteboard</td>
</tr>
<tr>
<td>Facebook</td>
<td>89</td>
<td>8</td>
<td>i use facebook often to get connected with my fellow friends and students.</td>
</tr>
<tr>
<td>Search engines</td>
<td>72</td>
<td>11</td>
<td>Using google most of the time as my search engine, it is easier to find what I am looking for, for my lesson.</td>
</tr>
<tr>
<td>Collaboration</td>
<td>63</td>
<td>3</td>
<td>no collaboration online, but offline, we tried to share our resources, notes, exercises, any interesting stuffs with colleagues whenever can.</td>
</tr>
</tbody>
</table>
Professional development 52 19 I am scared to attend workshop cos school thought that I could share to others but I am not fast learner so I still need colleague to assist me.

E-mail 43 2 Websites that are usually visited are google, facebook, hotmail/outlook, youtube and other websites that are needed for personal, professional or teaching purposes.

YouTube 42 6 Also, using Power Point, I am able to use different fonts and colours, adding still and moving graphics which spark an interest in students' attention, adding video that I downloaded from YouTube also helps to catch their attention and plus promoting the use of Internet to search for valuable information about their subject.

Presentations 41 17 Digital projector, Microsoft Power point & Excel, Microsoft Word, You tube, & Google.

Bandwidth 39 5 Weak signal receiver for Internet access in the school area and some of the sites which teacher wants to go to are being restricted by MOE.

In order to provide a coherent, relevant, and consolidated description of the various themes related to online teacher professional development, the researcher classified themes into four main categories: (1) use of the Internet, (2) technologies, (3) teacher professional development strategies and opportunities, and (4) collaborative learning experiences. Each of these main categories is likely to impact on the extent to which teachers are able to participate in online communities.

5.2.11. Use of the Internet

Teachers mentioned they were familiar with Facebook for social networking, Internet browsers, YouTube, and search engines. It appears they learned online tools as and when
they needed to without difficulty. When they did need assistance to learn a new online tool, they usually referred to friends, family, and colleagues for advice. If teachers are familiar with learning new online tools for their own purposes, as appears to be the case, then it is reasonable to expect they will be able to learn new tools as and when required for online, collaborative, professional learning activities.

5.2.12. Technologies

Laptops with wireless Internet access, 3G mobile phones, and 3G tablets are all suitable devices currently being used by teachers in Brunei. In particular, 3G mobile phones (when tethered to a laptop) are useful because they may be used to connect to the Internet without the need to rely on institutional facilities (see TT-4’s comment below). There were 43 TPACK responses that mentioned the use of mobile phones for Internet access, indicating the practice is widespread within this group of teachers. The use of mobile 3G devices is an expense borne entirely by teachers, and this goes some way to supporting the argument that science teachers in Brunei are committed to the use of the Internet for sourcing teaching resources as well as being connected to other teachers (e.g. Facebook and Twitter). Despite Internet access barriers in schools, teachers have developed workarounds that overcome the challenges.

**TPACKBRU-Feb (TT-4)**

“I usually used mobile phone when I want to go online because easy for me to bring it anywhere.”

There are many teachers in Brunei, like TT-4, who are remarkably adept at working out a course of action to achieve goals once they know what is expected of them. Throughout the study, the researcher observed this with teachers time and time again. For example, some teachers developed their own way of assessing the extent to which students had learned science content knowledge and developed relevant skills. Within a short amount of time, this group had independently developed a feasible mechanism for completing assessments in their school that was considerably more effective and feasible than that which they had been provided. This suggests that when teachers are insulated from micro-management of their activities, they will work out creative and innovative ways to achieve their goals.

The following comments by PD-3 further illuminate some of the reasons why teachers want to be able to connect. These show she has primarily considered the use of
technologies to promote transmission mode classroom practices such as digital presentations with a data projector and videos.

**TPACKBRU-Feb (PD-3)**

*Of all the labs, im currently using, there is only 1 that has a projector. This is the only time I can use PPT slides to teach. Borrowing the portable projector is also a hassle as there are many other teachers using it. I prefer using laptop+ projector over the whiteboard as i can show science experiment video demonstrations, etc. This not only saves a lot of time, but the students actually love all the videos, etc. I want to give students online tutorials/assessments but it is almost impossible because most of them do not have Internet access at home. Not only videos, colourful, animated images could also be shown to the students (3D animated images are better than dull, outdated textbook images). This is beneficial for the students as they can see the different examples i can show to them. videos are usually obtained from the ones uploaded on youtube, which have been quite useful.*

However, PD-3 also provided some indications she has thought about using technology to increase the speed at which she teaches, to provide multiple modes of content transmission (video, PowerPoint and animation to match student learning styles), and to make lessons more engaging for students. PD-3 made no direct mention of the use of technology to deepen understanding beyond what otherwise might be achieved without technology. Although one teacher did respond in her TPACK-Feb answers that she thought it would be helpful to have “*Software for making science teaching and learning easier*” (PD-2), most teachers focused on the use of the Internet as a source of content and as a place they might go for their own professional development. Mostly, teachers seemed to believe that technology may be used to promote professional development through the sharing of information (e-mail), and connection with other teachers (Facebook).

Twitter is widely used to support professional learning networks in developed countries; teachers broadcast a request for an answer, and an expert somewhere provides a viable solution. However, in the setting for this study, very few teachers mentioned using Twitter at all, let alone in a professional collaborative learning context.

There are several technological barriers identified by teachers that might hinder their capacity to participate in on-going online teacher professional development. The first barrier is an inadequate technology platform. Not a single respondent to either TPACK-
Feb or TPACK-Sep reported having access to (1) enough technology, (2) technologies of the right type and configuration, and (3) technologies in the right locations to meet their needs.

Wireless access, when provided in schools, was frequently described as unreliable with poor coverage and low bandwidth. Under these conditions, even when teachers used their own laptops, they still could not connect to teachers in other schools unless they paid for an alternative method of connecting to the Internet. In addition, the Ministry of Education in Brunei blocks websites teachers regularly use for professional learning, including YouTube and Facebook. The blocking of Facebook for teachers is especially problematic because Facebook is by far the most common communication technology that teacher research participants use (mentioned 89 times in teacher TPACKBRU answers).

TPACKBRU-Feb (LU-6)  

in most cases whenever time permits i would try to use the digital projector and laptop for lessons. i carry around a portal[sic] [portable] broadband device which helps to connect to the net if ever require. sometimes i surf for useful sites n uses this online to show to students to try to give them an appreciation of the Internet and what information you can get, e.g. the national geographic website for kids or even videos from youtube.

Again, at the risk of repetition, technology constraints challenge teachers to come up with ways and means to sustain online professional learning, but this being said, it seems teachers, left to their own devices, came up with the solutions needed to overcome these barriers.

It is easy to support an argument that the Brunei science teachers who participated in this study are committed to the use of technology. With the exception of two teachers, all reported purchasing their own laptops, which they use for work purposes. In addition, most teachers pay a monthly fee for private access to the Internet, and nearly all own either an iPhone or an Android smartphone with 3G Internet access. Some teachers use their own digital equipment to overcome the challenge of little or no Internet access in science classrooms by either tethering their laptop to their 3G phone or using their personal USB Internet dongle.
Few teachers indicated they use technology for anything beyond content transmission (presentations and videos). One or two teachers mentioned the use of visualizers, and two teachers mentioned using a digital microscope in their classroom. However, teachers expressed a strong and consistent view that Brunei schools lack the necessary technology platforms with the right types of technology, in the right locations, and in sufficient quantity to support digital age learning in classrooms.

Teachers in this study indicated they use digital technologies frequently, and for three main purposes: to prepare lesson plans and to complete class management tasks, to find resources to include in lessons, and as a resource for professional learning.

The answer provided by ME-3 below illustrates how teachers in Brunei think of using technology to increase efficiency. These teachers often repeat the same lessons to several different classes each week. To prepare for this, teachers like to develop teaching resources that may be used more than once. For example, ME-3 teaches the same lesson to four different classes each week.

**TPACKBRU-Feb (ME-3)**

“As I usually have to repeat my lesson four times (four classes), teaching using Power Point really helps to reduce any unnecessary loss of time [there's only less than 50 minutes per lesson].”

Mostly, teachers go beyond the use of technology to increase teaching efficiency to include enhancement of lesson content. YouTube educational video downloads were mentioned 42 times in the TPACK-Feb responses, indicating that teachers are able to locate, evaluate, download, and format videos for delivery in science lessons.

Teachers did not explain how they selected videos from the large number available at YouTube, or the criteria they used for selection. However, it is clear that teachers, in part, are learning how to use technologies in learning situations by themselves, that they are adept at locating resources online.

**TPACKBRU-Feb (ME-2)**

“Most of the time I’d download youtubes videos that is related to their lesson to show my students.”

In the following extract, LU-3 describes how she might find videos using Google. Implicit in many comments that are similar in meaning to the one made by LU-3 is that
these teachers do not have access to a local library of digital resources suitable for
teaching science. Furthermore, it may be inferred from such comments that there is no
nationwide community of teachers who may facilitate the sharing of videos and other
resources.

TPACKBRU-Feb
(LU-3) “...Using google most of the time as my search engine, it is
easier to find what I am looking for, for my lesson.”

In addition, the Internet is mentioned as a place teachers go when they are looking for
lesson plans, assessment rubrics, and information about best pedagogical practices:

TPACKBRU-Feb
(SA-3) “For preparing lessons, i usually used the Internet to search
for any relevant ideas on how to teach different topics in
Science.”

Two teachers mentioned they upload documents to an Internet Moodle server and then
make these resources available for other teachers to download. Although this practice
might seem to be an excellent way for teachers to share resources, it was a practice that
was rarely reported in teacher questionnaire responses. There are ample comments made
by the research participants (teachers) that show teachers learn by themselves, and
professional learning is largely ad-hoc and up to the individual teacher to organise for him
or herself. For example, JE-3 describes her use of YouTube instructional videos to learn
technology skills.

TPACKBRU-Feb
(JE-3) “I sometimes learn it by myself through exploring or watch
YouTube on how to use the equipment or software.”

Five teachers, including IC-4 below, indicated they upload documents for storage and
sharing online, and the rest made no mention of sharing online. This suggests only a few
teachers were familiar with the idea of having an online library of resources that they
maintain with other teachers.

TPACKBRU-Feb
(IC-4) “...using skydrive in our school email where we can upload
our documents and teachers can have access to this document
and use it in their lesson.”
5.2.13. Collaborative Learning Experiences

How teachers learned before participating in the TestLed professional development programme is of relevance for this study. If teachers had prior experiences of collaborative learning, they may also have had some knowledge of how to participate in a PLC. If, on the other hand, teachers’ professional development experiences were limited to short duration centralized workshops, they may have much to learn about participation in a learning community.

"in most cases whenever time permits i would try to use the digital projector and laptop for lessons. i carry around a portal broadband device which helps to connect to the net if ever require. sometimes i surf for useful sites n uses this online to show to students to try to give them an appreciation of the Internet and what information you can get, e.g. the national geographic website for kids or even videos from youtube."

Most teachers in this study use data projectors and laptops to make PowerPoint presentations for classroom teaching. The word "projector" occurred 133 times, and "laptop" was mentioned 134 times in the TPACK questionnaire responses.

Teachers also indicated they used search engines to locate resources for teaching on the Internet as evidenced by the term "Google" being mentioned 82 times by the 53 TPACK-Feb respondents.

The term “YouTube” occurred a significant 40 times for at least two reasons. Firstly, teachers like to use YouTube videos when they are teaching science, and secondly, they use YouTube videos when they need to develop some knowledge or a new skill.

5.3. Summary

This chapter has provided a brief summary of the characteristics of each of the 10 communities in this study. TPACK questionnaire responses indicate teachers are both able and willing to learn and use technology in their classrooms, but that circumstances dictate that their use of technologies is somewhat limited to infrequent PowerPoint presentations and even less frequent access to Internet search engines or subject specific sites. Furthermore, as might be expected when there is only limited access to technologies
in classrooms, there is little in the way of effective professional development that might show teachers how to use technologies. Teachers mentioned that they often learned casually from friends, family and colleagues as and when they needed to. Some also learned by themselves, from manuals and video tutorials. In any event, at the time of this study, it is clear that training for the use of technology was unevenly spread. The capacity to use technologies for learning (communication technology knowledge and prior CPL experiences) was variable and largely dependent on the circumstances of each individual teacher.

This being said, there is ample evidence in this section to show teachers are very positive about learning collaboratively to solve their own teaching and learning problems. However, learning together brings about a new set of challenges for teachers, especially if they are to use online tools for this purpose. For example, some may need to develop research skills, project management skills, multiliteracies, and community building skills if they are to form effective knowledge producing communities. What appeared to be evident was that teachers were very open to new ways of professional development, but that they needed long term training, support systems, and recognition of their efforts to make this happen.
Chapter 6. Characteristics of High and Underperforming Communities

6.1. Introduction

This chapter presents the findings arising from the analysis of Moodle server logs, which identified differences in project performances between individuals within learning communities and the differences in overall project performances of different communities. The aim of this analysis was to identify the characteristics that differentiate high performing learning communities from those that are less successful.

The chapter is divided into six sections. The first section describes the results of quantitative analysis of Moodle activity frequency distributions. The second section presents a summary of individual teacher characteristics, and the third section shows the different approaches community teachers used to engage in projects. The fourth section describes how teachers communicated with each other online, and the fifth section describes how community teachers coped with the learning load associated with OLC. The chapter concludes with a summary. The findings of this chapter are discussed in Chapter 9

6.2. Quantitative Analysis of Activity Frequency Distributions

This section is divided into three subsections. The first subsection describes teacher and community numbers as they were formed into two cohorts. The second subsection presents the results of a coding process used to preserve community teacher anonymity. The final subsection describes the results of analysis of Moodle activity levels.

6.3. Research Participants

The research participants for this study, 47 in total, were divided into two streams: TestLed A and TestLed B. The teachers were divided into two groups out of necessity; there simply wasn’t a venue available for professional development workshops that could hold more than 30 participants and so workshops were repeated in two sessions. Each group independently participated in eight ICT workshop sessions over four months. Both TestLed A and TestLed B received the same workshop content from the researcher. Within each group, teachers formed learning communities of between three and six teachers. Teachers were able to join the OLC of their choice subject to two conditions.
Firstly, no two community teachers were to be drawn from the same school. This rule helped to ensure community teachers would not be able to meet each other offline at work – a required condition for this study of on-line learning communities.

6.4. Coding of Communities and Teachers

The names of communities and the names of OLC teachers were coded so research participants’ identities would be protected in any research publication. The codes for learning communities and OLC teachers are shown in Table 20. Online Learning Community codes

<table>
<thead>
<tr>
<th>Learning Community code</th>
<th>Learning Community Member codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC</td>
<td>IC-1, IC-2, IC-3, IC-4 (4 teachers)</td>
</tr>
<tr>
<td>MA</td>
<td>MA-1, MA-2, MA-3, MA-4 (4 teachers)</td>
</tr>
<tr>
<td>ME</td>
<td>ME-1, ME-2, ME-3 (3 teachers)</td>
</tr>
<tr>
<td>PD</td>
<td>PD-1, PD-2, PD-3, PD-4, PD-5 (5 teachers)</td>
</tr>
<tr>
<td>SA</td>
<td>SA-1, SA-2, SA-3, SA-4, SA-5 (6 teachers)</td>
</tr>
<tr>
<td>TT</td>
<td>TT-1, TT-2, TT-3, TT-4, TT-5 (5 teachers)</td>
</tr>
<tr>
<td>FA</td>
<td>FA-1, FA-2, FA-3 (3 teachers)</td>
</tr>
<tr>
<td>JE</td>
<td>JE-1, JE-2, JE-3, JE-4, JE-5, JE-6 (6 teachers)</td>
</tr>
<tr>
<td>LU</td>
<td>LU-1, LU-2, LU-3, LU-4, LU-5, LU-6 (6 teachers)</td>
</tr>
</tbody>
</table>

6.5. Analysis of Moodle Activity Frequency

Teachers in learning communities were provided with Moodle accounts so they could log into a Moodle site to complete project discussions and other professional development activities. Some results of the quantitative analysis of Moodle server logs are presented in
Appendix G and Appendix J. These appendices provide supporting evidence for a number of the assertions made throughout this chapter.

Teachers in learning communities participated in many online discussions and other Moodle activities as a part of their on-going TestLed professional development programme. A project had two parts to it. Firstly, teachers participated in an investigation of a teaching and learning problem by going through guidelines for conducting an evidence-based professional learning conversation. Secondly, teachers investigated the capacity of their team to meet collaborative professional learning goals.

The results displayed in Table 22 show that communities in TestLed A engaged in five Projects and communities in TestLed B completed six Projects each. School and public holidays affected the flow of TestLed B contact sessions more often than they affected TestLed A classes. The results in Table 21 show the number of Moodle activities that MA teachers engaged in during their TestLed professional development programme.

<table>
<thead>
<tr>
<th>Name / Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA-1</td>
<td>15</td>
<td>72</td>
<td>79</td>
<td>172</td>
<td>405</td>
<td>691</td>
<td>296</td>
<td>7</td>
<td>215</td>
</tr>
<tr>
<td>MA-2</td>
<td>11</td>
<td>80</td>
<td>90</td>
<td>60</td>
<td>168</td>
<td>223</td>
<td>313</td>
<td>14</td>
<td>136</td>
</tr>
<tr>
<td>MA-3</td>
<td>7</td>
<td>39</td>
<td>173</td>
<td>52</td>
<td>25</td>
<td>775</td>
<td>344</td>
<td>12</td>
<td>320</td>
</tr>
<tr>
<td>MA-4</td>
<td>5</td>
<td>74</td>
<td>125</td>
<td>129</td>
<td>195</td>
<td>162</td>
<td>318</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The results in Table 21 are represented in Figure 11. This bar chart shows MA teachers were actively engaged in their online professional development activities throughout the TestLed programme, with a break during the August holiday period.
A list of Moodle activities is listed in Appendix H. Some Moodle activities are more important than others in the context of this research and the related TestLed professional development programme. Moodle activities that promote professional learning in communities include project discussions, wiki building, and online chat.

The number of project discussions was different for each cohort, because TestLed A had more learning communities than TestLed B did, and therefore, had more communities generating discussions while engaged in project activities than TestLed B did. Learning communities engaged in a *Teaching and Learning* (teaching and learning) investigation and a metacognition analysis process during each project.

**Figure 11.** Activity frequency distributions for MA teachers
Table 22. Number of Moodle discussions conducted by learning communities

<table>
<thead>
<tr>
<th>Session</th>
<th>Forum</th>
<th>TestLed A</th>
<th>TestLed B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Classroom investigation</td>
<td>73</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Community performance</td>
<td>91</td>
<td>72</td>
</tr>
<tr>
<td>2</td>
<td>Classroom investigation</td>
<td>44</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Community performance</td>
<td>89</td>
<td>37</td>
</tr>
<tr>
<td>3</td>
<td>Classroom investigation</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Community performance</td>
<td>98</td>
<td>57</td>
</tr>
<tr>
<td>4</td>
<td>Classroom investigation</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Community performance</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>Classroom investigation</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Community performance</td>
<td>20</td>
<td>38</td>
</tr>
<tr>
<td>6</td>
<td>Classroom investigation</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Community performance</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>527</strong></td>
<td><strong>462</strong></td>
</tr>
</tbody>
</table>

The results presented in Table 23 reveal that teachers completed a total of 989 separate discussions and 25,519 discussion-related activities. These results reported in Table 23 reveal that teachers viewed the work of fellow participants in their communities a total of 19,384 times. Community teachers posted to online discussions a total of 4,620 times between January and September of 2011.

Table 23. Discussion activity summary for all community teachers

<table>
<thead>
<tr>
<th>Forum Activity</th>
<th>Description of activity</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>View discussion</td>
<td>Opens a single discussion for viewing</td>
<td>10809</td>
</tr>
<tr>
<td>View forum</td>
<td>List of community discussions in a session</td>
<td>8575</td>
</tr>
<tr>
<td>Add post</td>
<td>Make a discussion post</td>
<td>3616</td>
</tr>
<tr>
<td>View forums</td>
<td>List all sessions</td>
<td>1356</td>
</tr>
</tbody>
</table>
The average ratio of postings to views is 1:5, which shows participants in this study to be more active than might be expected in a typical online social networking environment. The 90-9-1 rule is widely used to describe levels of participation in online communities. This rule says that 90 percent of online participants will view the work of others, nine percent will occasionally contribute, and only one percent of participants will contribute regularly (Hill, Hollan, Wroblewski, & McCandless, 1992). Community teachers contradicted the 90-9-1 rule with the 1:5 discussion postings to views ratio. According to Salmon (2005), it is necessary that teachers actively participate in discussions during project activities; the results shown here support an argument that, by and large, this was the case.

When the direction of a discussion was explicitly stated in the first discussion posting, the postings that followed were mostly focused on the topic at hand and were rich in content, as examples presented later in this chapter will attest to. The following project discussion posting is typical of the type of posting teachers made in the more detailed project discussions:

**MA-4**
19 July 2011, 07:05 P.M.

*PLC helps in a lot of areas but to implement it is always quite difficult. In my school, science teachers are of a range of age and they stick to their beliefs even they agree what we shared is good. We mentioned a few times during meeting to share resources but it never seemed that they honestly wanted it to be done. No teachers have put up their resources as to date. If young teachers started it, negative feedback is given more than the positive ones.*

Discussion deletions and post deletions were rare. No inappropriate discussion posts were, or needed to be moderated, indicating that teachers in this study were well aware of social networking etiquette. Sometimes, posts were altered or deleted (by the authors), but
this was usually because a teacher had accidentally posted to a discussion thread different to the one intended. Also, from time to time, teachers reworded postings they had previously submitted, but Table 22 indicates this to have been an infrequent event.

There are numerous instances observed throughout this study (and reported later in this chapter) that show these Brunei teachers to be creative and innovative problem solvers. Challenged by Internet access barriers, teachers adopted the more accessible Facebook and SMS communication tools to supplement Moodle discussions. Faced with the limitations of Facebook and SMS modes of communication and their perceived English language weaknesses, teachers adopted their own community languages for use in online discussions. The following two Moodle transcript excerpts (from different community discussions) show how teachers made use of Facebook and other technologies to supplement Moodle communications.

MA-3  
Monday, 18 July 2011, 08:41 A.M.  
Okay ladies, its time to continue what we discussed the other day on Facebook, where we all agreed to investigate on the reasons why the student-centred method of teaching is not yet fully applicable in Brunei schools. We discussed how all of us found that many of our students still heavily rely on teacher’s spoon-feeding in order to get ahead in class and their work. We also agreed on investigating the reasons why teachers find student-centred lessons can be difficult to implement.

SA-2  
Sunday, 14 August 2011, 10:02 P.M.  
only people who have been in tested know what moodle is. Usually we communicate using Facebook, MSN, SMS, Whatsapp. To communicate with member of department we still use the ‘contact time /meeting’. By doing that, we receive immediate feedback and everyone is trying to deliver our thoughts and ideas verbally.

The following LM discussion excerpt is indicative of some of the reasons teachers preferred to use Facebook rather than other communication modes.

LM-4  
14 April 2011, 09:35 P.M.  
Were the communication technologies (mediating artefacts) suitable for use by teachers of the project (subject) given that some teachers may not have technological skills and knowledge, equipment or Internet access?
The communication technologies is suitable for us to use by teachers of the project given that some of our teachers may not have technological skills and knowledge. However, this communication technologies (moodle) is quite difficult to be accessed by those who has limitation in Internet access. FB is much better ;)

agree with you...Fb is much better as it is friendly user .... kali jua h...salnya sanang bah..iyatah yang debunk kan ampir hari hari...

[Facebook is much better as it isfriendlier to use and maybe because of that people will reply in only a few days]

yeah it is suitable as I believe most of the teachers can learn so that they can increase their technological skills, knowledge, equipment or Internet access. The teachers who involve in this programme should be given enough time to do their learning properly and the schools should give them less important work or activities.

so far so good...everybody seems to be able to use the media as a form of communication. just that it is not our favourable mode of communicating with each other. Any way, it’s a new thing to us and we definitely do learn something new from this media.

Teachers found Facebook to be easier to access and more user-friendly than Moodle; they also found responses and postings to discussions were more timely. As the discussion above reveals, LM teachers chose to employ technologies that were easy to use and readily available, but they did not take into consideration the extent to which they were fit for the purpose. Facebook does not allow for file sharing, or provide access to detailed, organized, and accessible discussion transcripts. It also does not provide web analytical data that teachers might use to analyse OLC performances, nor does it have facilities that an e-moderator might use to support a learning community. One consequence of teachers using a range of different communication strategies is that Moodle statistics (presented in the following paragraphs) may well understate the frequency of community teacher communication.

The results shown in Table 27 reveal the average number of Moodle discussion postings published by all research participants is 74.36, suggesting on average, teachers were making approximately 10 postings per month. In addition, skewness, kurtosis, and the difference between the mean and median all support an argument that posting frequencies are not normally distributed.
Table 24. Overall project discussion posting statistics

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>45.00</td>
</tr>
<tr>
<td>Mean</td>
<td>74.36</td>
</tr>
<tr>
<td>Median</td>
<td>58.00</td>
</tr>
<tr>
<td>Grouped Median</td>
<td>58.00</td>
</tr>
<tr>
<td>Std. Error of Mean</td>
<td>8.529</td>
</tr>
<tr>
<td>Sum</td>
<td>3346</td>
</tr>
<tr>
<td>Minimum</td>
<td>0</td>
</tr>
<tr>
<td>Maximum</td>
<td>205</td>
</tr>
<tr>
<td>Range</td>
<td>205</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>57.21</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-0.693</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.621</td>
</tr>
</tbody>
</table>

The Kolmogorov-Smirnov test was applied to the distribution of project discussion postings to determine whether the number of postings per research participant fitted a normal distribution. Applying the Kolmogorov-Smirnov test at the alpha = 0.05 level of significance produced p-value = 0.029 and statistic = 0.141, confirming the earlier prediction that the overall posting frequency distribution is not normally distributed. More specifically, this statistic lends support for a bi-modal distribution: one group of community teachers with high discussion posting frequencies and a second cluster of community teachers with lower discussion posting frequencies. The variation in community posting frequency distributions is graphically highlighted in the following box whisker plot.
Results show there were significant variations in posting frequency both within and between communities. A comparison of community box plots indicates the possibility that interquartile range size may be a predictor of posting frequency levels. Those communities with large interquartile ranges appear to have relatively low median posting frequencies, while those communities where all teachers contributed similar numbers of postings appear to have high median posting frequencies. Those communities with large interquartile ranges include IC, JE, PD, and LU; those considered to have small interquartile ranges are FA, LM, MA, ME, SA, and TT. The box whisker plot shown in Figure 12 reveals MA, LM, and SA posted to online discussions more frequently than the other seven communities in the study. Figure 12 also shows there is a wide range of posting frequencies generated by teachers of the LU group compared to other communities. Additionally, results indicate the presence of four statistical outliers in the community posting distributions. These have been coded as 18, 36, 38, and 40 in Figure 12, and represent teachers who generated posting frequencies that were either much higher or much lower than those of other teachers of their OLC.
The three learning communities with the highest median posting frequencies (a high level of activity) are MA, LM, and SA. Each of these learning communities generated relatively small interquartile ranges. In other words, a characteristic of high performing learning communities is that all community teachers contribute similar numbers of project discussion postings. The reverse is not however true; small interquartile ranges for posting frequencies did not mean high levels of participation. Other factors such as the size of a community may influence the activity level of a community.

Results shown in Figure 12 also reveal there are four discussion posting frequency distribution outliers. As mentioned above, outliers represent teachers who have either very high or very low discussion posting frequencies compared to others in their OLC. For example, PD-5 is an outlier, having published 108 (64%) discussion postings, while the other four teachers of her community produced 60 (36%) postings between them. LM-5 is also an outlier as a result of being mostly inactive and generating only 11 (3.0%) of LM discussion postings (see Table 60 in Appendix J). The remaining two outliers are both in SA. SA-2 contributed 104 postings and SA-4 published postings 48 times.

The above analysis suggests that successful learning communities have two common characteristics: firstly, a successful community has at least four active teachers; secondly, all teachers have similar posting frequencies.

Evidence of participation in online discussion by all teachers of a community is desirable because it indicates a community is making use of the collective knowledge and experience of all its members. Results from this study show that when a community has more than three active teachers, and when the community teachers have similar discussion posting frequencies (small interquartile posting frequency distribution range), the community will display high levels of online activity. When the community discussion post frequency interquartile range is high, online activity levels are low. If a community has three or fewer active teachers, it will also have low levels of online activity.

When only a few community teachers produce project discussion postings, it may indicate a community is not functioning to its full potential. Underperforming community teachers were quickly identified through analysis of Moodle server logs, and therefore, in
this context, the results of web tracking statistics were useful for analysing community performance. This type of analysis is limited though; while it helps to identify learning communities that are underperforming because teachers are not participating in discussions, it does not provide the reasons why this is so. Other types of analysis are required to understand what problems might exist in a community, and therefore, which strategies might help to encourage improved community performance. Furthermore, while content analysis of discussion transcripts revealed that the most influential teachers in project activities were not always the most prolific contributors, web tracking statistics may have identified such teachers as underperforming (see Chapter 7 for a comprehensive discussion of this topic). Additionally, the confounding influence of the use of Facebook, texting, and similar communication modes may, to a certain extent, limit the reliability of web tracking statistics as a measure of community performance.

6.6. OLC Teacher Characteristics

Teachers in learning communities came together from unique backgrounds, with individual dispositions, skills, knowledge, beliefs and teaching experiences. These individual characteristics shaped the way individuals interacted in a community. The results of this study suggest there are numerous individual success factors, listed in Appendix I, that may directly or indirectly impact on community performance. These factors may be grouped into a consolidated list of three general sets of success factors: *individual values*, *predispositions*, and *learning context*. Each of these factors is briefly introduced in the following paragraphs and further discussed in Chapter 7.

There is widespread support from researchers investigating continuing professional development who “point to the crucial importance of teachers’ values such as motivation, aspiration, and willingness to collaborate in order to enhance professional learning” (Bates, 2012, p. 512). Friendship is highly valued by the teachers of high performing learning communities. Although teachers were not directly asked whether they valued friendship with their community colleagues, there were many comments about the importance of friendship in the TPACKBRU responses (Chapter 5), and many teachers volunteered comments about the value they placed on friendship in their community performance discussion transcripts and community performance reports. The following community discussion excerpts are indications of the importance of friendship as an enabler of learning for community teachers:
Thumb up for both kim and jade ..i was lucky to be in this group, the group teachers have help me alot. Thanks gals hehe...btw what to say about the topic on subject? The good things are: -My group teachers are really helpful (balik2 jua ku tulis ane heehaw), but it is TRUE about my group teachers. Like X-files: The truth is out there
-Hardworking
-Cheerful (mask juba kHz 2)
-They are very enthusiastic to do this kind of things - Good job everyone..keep up the good job

The teachers of our group can maintain our relationship because we have been friends in unit and we are friends in FB so it is easier to communicate with each other.

i am not a fast learner. Find hard to share/communicate with others outside our project as unable to explain to them. Need buddies that have patience to help me.huhuhu

With friendship comes the empathy and understanding that helps to build community cohesion and the relationships of respect and challenge that help ensure professional learning takes place when teachers talk to each other during project activities.

In the context of this study, a successful community consists of teachers who consider themselves equals. There is an aversion towards the idea of leadership amongst the teachers of successful learning communities. Less successful learning communities were characterized by vertical management structures. MA is a community that employed a horizontal management structure:

We did not decide on anyone to be the leader. In our group, we are more towards agreeing than debating. Hence, work can be done more easily. Only our group have problems in managing time to complete tasks.

LU is less successful than other learning communities in the sense there is evidence only a minority of LU teachers contributed to discussions. LU is a community that used a vertical management structure:

Teacher LU-5 is our leader, [LU] Group is so bless with such dedicated teacher. Thank you so much for your hard work. I wish I can assist her more, but I have my limitation.
In this study, a characteristic of learning communities with a vertical management structure is the community leader seems to be disproportionately active online. The designated leader of LU completed many more project tasks than anyone else in her OLC. A consequence of LU-5 completing many tasks single-handedly is other teachers in LU did not participate in many of the activities that provided opportunities for individual professional learning. In addition, decisions made and conclusions drawn from project discussions were often based on the views of only two teachers. The following table shows that LU-1 and LU-5 contributed most of the project discussion postings for their OLC. In addition, the wiki was created by LU-5 (125 wiki edits) as an individual activity rather than as the collective knowledge building activity wiki building was designed to be.

Table 25. Moodle activity level statistics for LU

<table>
<thead>
<tr>
<th>Activity</th>
<th>LU-1</th>
<th>LU-2</th>
<th>LU-3</th>
<th>LU-4</th>
<th>LU-5</th>
<th>LU-6</th>
<th>Med</th>
<th>LQ</th>
<th>UQ</th>
<th>IQR</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>22</td>
<td>4</td>
<td>19</td>
<td>8</td>
<td>35</td>
<td>24</td>
<td>20.5</td>
<td>7</td>
<td>26.75</td>
<td>19.75</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td>Chat view</td>
<td>10</td>
<td>5</td>
<td>9</td>
<td>14</td>
<td>9</td>
<td>13</td>
<td>9.5</td>
<td>8</td>
<td>13.25</td>
<td>5.25</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>106</td>
<td>4</td>
<td>3</td>
<td>1.75</td>
<td>31.75</td>
<td>30</td>
<td>106</td>
<td>1</td>
</tr>
<tr>
<td>Forum add post</td>
<td>119</td>
<td>15</td>
<td>39</td>
<td>1</td>
<td>87</td>
<td>23</td>
<td>31</td>
<td>11.5</td>
<td>95</td>
<td>83.5</td>
<td>119</td>
<td>1</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>342</td>
<td>59</td>
<td>133</td>
<td>107</td>
<td>443</td>
<td>89</td>
<td>120</td>
<td>81.5</td>
<td>367.25</td>
<td>285.75</td>
<td>443</td>
<td>59</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>125</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>33.5</td>
<td>33.5</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>Wiki view</td>
<td>19</td>
<td>3</td>
<td>35</td>
<td>50</td>
<td>620</td>
<td>57</td>
<td>42.5</td>
<td>15</td>
<td>197.75</td>
<td>182.75</td>
<td>620</td>
<td>3</td>
</tr>
<tr>
<td>Wiki view all</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>11</td>
<td>4</td>
<td>2.5</td>
<td>1</td>
<td>6.5</td>
<td>5.5</td>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>

Successful community teachers are also fair. They want to see all teachers are sharing the workload, and all teachers are participating to an acceptable level. When there is a horizontal management structure, each member of a community has a management responsibility that entails looking at project progress. The following excerpt from the MA Community Report illustrates how teachers wanted community workloads to be evenly (fairly) distributed.

In our group, all of us did all of the work because it is fairer to do things this way and our group did not have any leaders. We always remind each other about completing the tasks/discussion questions and this has worked for us before and we will continue to do this in the future. Every member in
the group is responsible in completing all tasks given and we did the work equally. Up till now we did not appoint any leader however we are fortunate to have someone to initiate and remind others on actually what to do/complete before the due date. Load allocations for this investigation were the same for all project teachers. Each member should do the same amount of work for it to be fair.

(MA Community Report – April, 2011)

Teachers of the MA group were aware of the activity levels of all other teachers in their community, and were aware of individual participation to support a collective effort. The following MA performance discussion excerpts illustrate how teachers reminded each other of project status and the individual responsibilities of teachers.

**MA-3**
8 June 2011, 03:46 P.M.
We chose not to elect a leader since we all had different workloads; work in different schools; different priorities at home, etc. And above all we are friends. So the only way we did it was by constantly reminding each other about doing the work despite knowing the fact that some of us may not be as efficient as others. Time management is one main factor, apart from availability of Internet access and also managing priorities.

**MA-2**
23 May 2011, 02:25 P.M.
all of us were responsible on this investigation and we did not actually divide the work, we just remind each other through facebook to login and answers the questions posted, luckily we managed to do it. however we have problems in managing time to complete the task.

**MA-4**
20 May 2011, 05:39 P.M.
We did not have a leader but we know what to do and what to be done for the investigations. The only problem was managing time efficiently.

Implicit in the remarks above is the fact that MA teachers are goal-oriented, in the sense they are determined that project activities get finished within predictable timeframes. Therefore, MA teachers constantly monitored the progress of their community and reminded each other when project tasks required action.

### 6.7. Teacher Predispositions

LC teachers in this study are digital natives; they were born into a digital age, and they all use digital technologies frequently. As reported in Chapter 5, all except one community teacher reported owning a laptop they used for work. TPACKBRU questionnaire responses further revealed teachers are familiar with a range of digital devices (Android
and Apple smart phones, tablets, laptops, and PCs), a number of web 2.0 tools, smart
phone apps, and numerous educational Internet sites. As mentioned earlier in this chapter,
teachers demonstrated readiness to support project development within their community
by using smart phones, tablets, laptops, and a range of communication technologies
including browsers, SMS, Facebook, and WhatsApp (also see Chapter 5).

All teachers in this study were familiar with Facebook, and therefore, they had experience
communicating online. Facebook was mentioned 89 times by community teachers in their
responses to the open-ended questions in the TPACKBRU questionnaire (see Chapter 5).
This questionnaire response evidence of Facebook use is supported by comments made
by community teachers when they participated in project conversations. Examples of the
reasons for using Facebook, as mentioned by teachers in numerous project discussions,
are:

MA-3
Tuesday, 7 June 2011,
10:59 P.M.
Facebook is more accessible by phone which is why some
of our previous discussions were reported via FB.
However, using the Moodle to discuss topics forces us to
get to work as opposed to browsing people’s statuses
whilst testled-ing on FB. Here

MA-1
Saturday, 21 May 2011,
10:01 P.M.
Discussion are often made on FaceBook instead of forums
provided. But in the end, after the discussion in Facebook,
forums are done with direct points.

SA-2
Monday, 11 April 2011,
10:51 P.M.
My communities really help each other a lot; keep
reminding each other to do their part in the PLC, asking
and discussing progress or problem arise in the
completion of PLC, willing to volunteer, agreed and
respect on each others constructive ideas or decision-
making, keep in touch with each other through e-mail,
SMS and Facebook ;)

It was reasonable to expect teachers would take time to come to terms with the concepts
of collective knowledge building, distributed cognition, and collective cognitive
responsibility (in addition to learning some software tools). The following LU discussion
segment describes how some teachers felt overwhelmed by the amount they needed to
learn.
Yes, we actually struggle a lot, due to too many unfamiliar skills we need to master in such a short period of time. If only we have more time I believe we can benefit more.

yes i agree with you.. its all new to use and sometimes the mind came up totally blank.

also i kesian for you guys who has to travel long distances to get to the course, i’m sure by the time you arrive, the mind is not working to full capacity...

Perhaps only after teachers experience the synergy that comes from working creatively on common teaching and learning problems will they be encouraged to believe in the value of teacher collaboration per se, and particularly in collective knowledge building for professional development. The following excerpts from a range of different project discussions are indicative such synergy did occur and support for project activities was widespread:

The project encouraged teamwork between each group member and reinforces the teachers' skills for improve teaching and learning. It also help us to stimulate conversation and communicating skills. It help us to be able to learn from one another thereby enrich their own teaching. Since this is the join learning, the conversations are so rich and so valued for each other.

I agree that project is a good thing. Teachers from different schools can share ideas and informations regarding anything at all....

Yes, meeting other teachers and students with similar aim to improve science questions which involve mathematics skills, they are able to come out with the best solution on how to help the students score higher marks in those type of questions.

At some point, having project does serves as an advantage to teachers who cant meet up at regular time. Without PLC, some discussion might not be able to take place since teachers have different commitment and teaching either morning or afternoon session. However, even though i have other workloads (e.g teaching and administrative works) at school, i tried my best to do the given tasks either at school when i finished my lessons or at home if i have some free times since it is my responsibility as a part of the group.
6.8. Learning Context

Teachers are mostly accustomed to participating in short duration and centralized workshops during which they are passive receivers of transmitted knowledge. Following engagement in professional development, Brunei teachers are often required to produce a capstone report.

Under such circumstances, teachers may see production of the capstone report as being useful in showing they have met professional development programme requirements. If teachers are more focused on summative report writing, they could miss many opportunities for professional learning that arise from full participation in project activities. This is one of the reasons why teachers in TestLed were asked to write about their community professional learning performance as well as to write about the results of a teaching and learning investigation.

The final learning context issue mentioned here is one of overloading. Overloading in the context of this study means not having enough time available to manage the OLC tasks being able to participate in activities in a timely manner. Field notes written at the end of each of 22 TestLed contact sessions, workshop attendance records, project discussion transcripts, and analysis of project capstone reports all point towards most teachers feeling overloaded with work to the extent that this impacted their project performances:

**TT-4**
13 April 2011
02:17 P.M.

Yeah i think that community do affect our PLC, because at the time being it is very difficult for me to manage the time since there are alot of school work that we need to prepare, plus with the SBAsL and also BCATs1. But I do try to find the free time for me to share ideas with everyone. I really.. really sorry about this if i’m too slow

**LM-1**
12 April 2011
02:29 P.M.

My major problem is time and the Internet connection. Teaching load and admin work results in less time for PLC.
The good point is that we can share our opinions with others group teachers even though we are not from the same school as long as we can assess to the Internet either at home or at school, but the problem is that time play an important role in order to conduct the project effectively. This is because the group teachers might have heavy workload at school that make him/her don't have time to assess Internet at school (due to teaching, marking, other commitment at school), at home might be we have time, but the problem, they is no Internet access.

Well...I am busy during my working hour and when I reach home I'm busy with my 2 daughter. Every time I want to do my work my daughter always get in between me and my work hehehe...My other problem is I only get Internet access in school or my parents house. I don't have e-speed at my place and the DST broadband connection is very bad

Teachers in the TestLed programme have regularly mentioned they have to multitask and prioritize activities to be able to participate in project activities. Therefore, the extent to which individual community teachers can apply planning and organizing skills may impact on the collective wellbeing of their whole community.

The following e-mail message from an ME teacher highlights the pressure teachers were under to be in several places at the same time.

Dear Mr Moroney,
I'm sorry I can't come on your workshop this Wednesday as I have attended so many courses lately and been missing my classes since 21st Feb. But no worry, I have talked to one of my group member ME-2 and if I'm not mistaken we are given a homework something like picking a topic and discuss it via online chatting through the MOODLE. Anyway, you last e-mail to us is about "Wikis". Is it possible if I drop by to UBD to see you and talk about this, probably during the school first term holiday? If it is possible, please inform me the time that you are available to see me okey. Thank you so much for your cooperation and very sorry for the inconvenience.

With regard,
ME-1

[The names of teachers have been replaced with corresponding community codes.]
There were only three ME teachers in the beginning, so when one teacher was unable to join the other two in professional learning activities, all ME teachers were affected. Indeed, ME teacher goodwill and trust may have been lost when the two remaining teachers of ME found their project workload had increased by 50 percent when ME-1 was not able to participate.

Many community teachers mentioned time management as perhaps their biggest concern; SA teachers mentioned time issues in 196 discussion quotations; and teachers in other learning communities were equally concerned.

Therefore, as a matter of course, it is necessary for teachers engaged in project activities to have the time they need to conduct project activities and training, and to ensure they have the appropriate project management tools and skills to manage resources and time. It is also apparent teachers benefit from understanding the professional learning significance of participation in project processes such as discussions and wiki building activities so they can prioritize important professional learning opportunities ahead of less significant activities.

The following list of community characteristics (Table 26) contrasts observed characteristics that appeared in successful communities with those that occurred in under-performing communities. The table highlights the importance of teachers developing relationships of trust, and the importance of teachers understanding the impact on others of the individual work scheduling and prioritizing decisions they make.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
<th>Successful community</th>
<th>Underperforming community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum number of active participants</td>
<td>Minimum of four active teachers participating in project discussions</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Friends</td>
<td>Teachers are friends</td>
<td>Yes</td>
<td>Cliques that talk amongst themselves</td>
</tr>
<tr>
<td>Trust, respect &amp; challenge</td>
<td>Teachers have established relationships of respect and challenge</td>
<td>Yes, safe to challenge the views of others</td>
<td>No</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------</td>
<td>----------------------------------------</td>
<td>----</td>
</tr>
<tr>
<td>Social development of the community</td>
<td>Teachers actively seek to develop and sustain their communityness</td>
<td>Yes, always</td>
<td>Some teachers may do this, but not all</td>
</tr>
<tr>
<td>Fairness</td>
<td>OLC teachers share professional development activities and responsibilities fairly</td>
<td>Yes</td>
<td>No – uneven distribution</td>
</tr>
<tr>
<td>Self-management</td>
<td>OLC teachers find ways to control and prioritize work from external activity systems such as schools and home</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Process not product</td>
<td>Teachers understand the process of learning is more important than project artefact production</td>
<td>Yes, mostly determined to conduct good discussions</td>
<td>No, focus is on report production and project completion</td>
</tr>
</tbody>
</table>

6.9. Processes and Procedures

Each OLC devised its own procedures and processes for completing project activities. Learning communities conducted their project discussions in isolation and needed to work out how to best use the human resources in their community to conduct project activities. Some learning communities were well-organized teams of teachers dedicated to achieving professional learning goals, other learning communities were less well focused, and included largely non-active teachers who contributed very little to advance online discussions. Some community teachers appeared not to have the necessary organizational skills to complete a large number of time-consuming tasks over an extended period of time; while others found ways to avoid a last-minute rush to complete project tasks by the deadline.
Results show the emergence of three themes related to procedures and processes: firstly, learning communities differed in their capacity to apply project management skills; secondly, learning communities differed in the way they interpreted and followed project completion guidelines; and finally, learning communities differed in their management style.

6.9.1. Project Management

Online learning community teachers with project management skills may have had an advantage when it came to organizing the completion of their project activities. When a community was able to maintain detailed information about project progress, this could be used to inform decisions about changing procedures and practices to improve professional learning performance.

To one extent or another, most community teachers were able to recognize project management issues and to adjust their methods to compensate for shortcomings. This report has already highlighted how some teachers adopted Facebook and SMS to reduce response times during project discussions. In addition, learning communities allocated project activities to individual teachers — sometimes successfully, and at other times, disastrously — as the following paragraphs show.

When teachers ran out of time to complete a project, they commonly adopted three strategies: (1) skip through activities quickly, giving them little thought or attention; (2) delegate responsibility for the completion of different tasks to individual community members; (3) try to allocate more time to remaining activities. When project completion processes were shortened or delegated, individual professional learning was compromised.

When teachers were pressed for time and could not complete an investigation of the performance of their community, procedures that inhibited professional learning were never changed. As an example of this, LU procedures and practices were never seriously questioned by LU teachers, and the same ineffective procedures and practices were repeated time and time again in consecutive project cycles.

The consequences of poor project management produced an incomplete or superficial project and limited professional learning progress. In some instances, teachers missed opportunities to learn how to negotiate meaning while constructing their wiki, and they
missed the chance to compare and contrast their own views about teaching and learning in project discussions. It was sometimes the case that activities such as wiki production — designed for collective knowledge building — were delegated to individuals.

Some learning communities adopted wikis and used them to support development of their professional learning knowledge base, while at the other end of the scale, some learning communities did not support the use of wikis for professional learning at all. As the following two tables show, JE teachers (Table 27) simply did not create wikis, and LU-5 (Table 28) completed LU wikis almost single-handedly.

**Table 27. Moodle activity level statistics for JE**

<table>
<thead>
<tr>
<th>Activity</th>
<th>JE-1</th>
<th>JE-2</th>
<th>JE-3</th>
<th>JE-4</th>
<th>JE-5</th>
<th>JE-6</th>
<th>Med</th>
<th>LQ</th>
<th>UQ</th>
<th>IQR</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>21</td>
<td>32</td>
<td>8</td>
<td>15</td>
<td>23</td>
<td>17</td>
<td>19</td>
<td>13.25</td>
<td>25.25</td>
<td>12</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>Chat view</td>
<td>3</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>8.5</td>
<td>5.5</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>7</td>
<td>45</td>
<td>50</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>3.75</td>
<td>46.25</td>
<td>42.5</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>Forum add post</td>
<td>18</td>
<td>102</td>
<td>107</td>
<td>52</td>
<td>14</td>
<td>28</td>
<td>40</td>
<td>17</td>
<td>103.25</td>
<td>86.25</td>
<td>107</td>
<td>14</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>126</td>
<td>344</td>
<td>394</td>
<td>193</td>
<td>72</td>
<td>95</td>
<td>159.5</td>
<td>89.25</td>
<td>356.5</td>
<td>267.25</td>
<td>394</td>
<td>72</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>1.25</td>
<td>1.25</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Wiki view</td>
<td>37</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>11</td>
<td>8.5</td>
<td>19.75</td>
<td>11.25</td>
<td>37</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Wiki view all</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2.5</td>
<td>2.5</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Table 28. Moodle activity level statistics for LU**

<table>
<thead>
<tr>
<th>Activity</th>
<th>LU-1</th>
<th>LU-2</th>
<th>LU-3</th>
<th>LU-4</th>
<th>LU-5</th>
<th>LU-6</th>
<th>Med</th>
<th>LQ</th>
<th>UQ</th>
<th>IQR</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>22</td>
<td>4</td>
<td>19</td>
<td>8</td>
<td>35</td>
<td>24</td>
<td>20.5</td>
<td>7</td>
<td>26.75</td>
<td>19.75</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td>Chat view</td>
<td>10</td>
<td>5</td>
<td>9</td>
<td>14</td>
<td>9</td>
<td>13</td>
<td>9.5</td>
<td>8</td>
<td>13.25</td>
<td>5.25</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>106</td>
<td>4</td>
<td>3</td>
<td>1.75</td>
<td>31.75</td>
<td>30</td>
<td>106</td>
<td>1</td>
</tr>
<tr>
<td>Forum add post</td>
<td>119</td>
<td>15</td>
<td>39</td>
<td>1</td>
<td>87</td>
<td>23</td>
<td>31</td>
<td>11.5</td>
<td>95</td>
<td>83.5</td>
<td>119</td>
<td>1</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>342</td>
<td>59</td>
<td>133</td>
<td>107</td>
<td>443</td>
<td>89</td>
<td>120</td>
<td>81.5</td>
<td>367.25</td>
<td>285.75</td>
<td>443</td>
<td>59</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>125</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>33.5</td>
<td>33.5</td>
<td>125</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Wiki view</td>
<td>19</td>
<td>3</td>
<td>35</td>
<td>50</td>
<td>620</td>
<td>57</td>
<td>42.5</td>
<td>15</td>
<td>197.75</td>
<td>182.75</td>
<td>620</td>
<td>3</td>
</tr>
<tr>
<td>Wiki view all</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>11</td>
<td>4</td>
<td>2.5</td>
<td>1</td>
<td>6.5</td>
<td>5.5</td>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>
In most cases, teachers collaborated to develop community wikis, and therefore, they all were able to experience opportunities to negotiate the meaning and form of their learning communities’ collective knowledge base. In the following table, it is evident that all MA teachers participated in wiki building activities.

**Table 29.** Moodle activity level statistics for MA

<table>
<thead>
<tr>
<th>Activity</th>
<th>MA-1</th>
<th>MA-2</th>
<th>MA-3</th>
<th>MA-4</th>
<th>Med</th>
<th>LQ</th>
<th>UQ</th>
<th>IQR</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>57</td>
<td>75</td>
<td>46</td>
<td>77</td>
<td>66</td>
<td>48.75</td>
<td>76.5</td>
<td>27.75</td>
<td>77</td>
<td>46</td>
</tr>
<tr>
<td>Chat view</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>3.75</td>
<td>8.25</td>
<td>4.5</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>35</td>
<td>2</td>
<td>7</td>
<td>67</td>
<td>21</td>
<td>3.25</td>
<td>59</td>
<td>55.75</td>
<td>67</td>
<td>2</td>
</tr>
<tr>
<td>Forum add post</td>
<td>111</td>
<td>113</td>
<td>114</td>
<td>90</td>
<td>112</td>
<td>95.25</td>
<td>113.75</td>
<td>18.5</td>
<td>114</td>
<td>90</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>423</td>
<td>360</td>
<td>380</td>
<td>276</td>
<td>370</td>
<td>297</td>
<td>412.25</td>
<td>115.25</td>
<td>423</td>
<td>276</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>141</td>
<td>50</td>
<td>99</td>
<td>16</td>
<td>74.5</td>
<td>24.5</td>
<td>130.5</td>
<td>106</td>
<td>141</td>
<td>16</td>
</tr>
<tr>
<td>Wiki view</td>
<td>530</td>
<td>174</td>
<td>460</td>
<td>66</td>
<td>317</td>
<td>93</td>
<td>512.5</td>
<td>419.5</td>
<td>530</td>
<td>66</td>
</tr>
<tr>
<td>Wiki view all</td>
<td>5</td>
<td>4</td>
<td>18</td>
<td>5</td>
<td>5</td>
<td>4.25</td>
<td>14.75</td>
<td>10.5</td>
<td>18</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 30 below summarises the main project management factors (discussed above) that varied from one community to the next. The table shows some factors present in all learning communities and others present in high performance learning communities that were absent in underperforming learning communities.

**Table 30.** Project management factors

<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
<th>High performance OLC</th>
<th>Low performance OLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time management</td>
<td>Can manage projects over extended periods of time.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Project management</td>
<td>Familiar with project management techniques</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>OLC performance data</td>
<td>OLC performance data collected for analysis</td>
<td>Some</td>
<td>Some</td>
</tr>
<tr>
<td>Completion</td>
<td>Completion of project discussions, investigations, wikis and reports</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>LC-evaluation</td>
<td>Teachers regularly assess the functioning of their OLC.</td>
<td>Yes</td>
<td>Sometimes, but somewhat superficially</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------------------------------</td>
<td>-----</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Problem solving</td>
<td>Improved community functionality once problems were identified</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

The results of web tracking statistics analysis appear, on the surface, to suggest that in some learning communities just a few teachers carried out the vast majority of work, as was the case when LU-5 completed the LU wiki. However, web tracking statistics may be quite misleading, as teachers may have made extensive use of tools (like Facebook), which did not provide web tracking statistics that could be used to monitor levels of interaction between teachers.

The following subsection (6.9.2) puts forward reasons why the results of web analysis may not always reflect fairly on community teachers. The appearance of disorganization and a lack of cohesion within some learning communities, as indicated by the quantitative analysis of web tracking data, is open to an alternate interpretation.

### 6.9.2. Project Discussion Protocols

All learning communities allocated a community teacher the task of setting up project discussions. Most of these teachers copied the guidelines for conducting project discussions directly into the first posting of project discussions. This may have been an effective way of ensuring community teachers knew the direction, purpose, and focus of the discussion in which they were participating. TT-3 and MA-4 (below) both initiated discussions in this way.

**TT-3**  
*12 July 2011, 02:53 P.M.*

*What does your group think is good or bad about this professional development approach? What has your group decided might be done to ensure that your next professional learning conversation is better than the current one?*

**MA-4**  
*18 May 2011, 02:03 P.M.*

*Do your project rules interfere with what you need to do with the other communities that you belong to?*
The following MA discussion shows how the initial community discussion posting, and those that followed, stayed focused on the topic at hand. This being said, the initial posting may have been usefully modified to request that community teachers suggest how they might modify the rules they had in order to better accommodate the tension between community requirements and the requirements of the workplace and home.

Do your project rules interfere with what you need to do with the other communities that you belong to?

Unfortunately, my contributions in this group did take a back seat half of the time we did the investigation because of school work really took most of my time but I managed to come back & complete the required tasks albeit it being not on time.

Actually, it does not. But with my bad time management at this time, I find it hard to have all the workload to be done on time. Other tasks in school requires a lot of my time apart from family time after work?

Actually it does not however with the school works and other responsibilities it is hard to balance and divide the time wisely.

Being a first time mother and raising my baby without the help of a domestic helper, I would have to say that yes my priorities towards work and home-life have been in a disarray. Juggling work and priorities at home have not been as 'systematic' as i hoped it would be. But slowly and surely, i try to find the time to get everything done. Even though it might come much later than others, but i assure you, i am trying my best

There is evidence to suggest that possibly, for some communities, completion of the project completion guidelines was a goal in itself. This was evidenced by discussions being created and completed in a short amount of time, the content of transcripts being somewhat superficial, and participation in conversations being limited to one or two teachers only. Only two LU teachers conducted the following community performance discussion, and therefore, one of the factors that impacted LU performance was never properly discussed.
No rules were created to enable our LU Group to function more effectively, so that we all share our burden together, whether we are successful or fail towards the end we all sail in the same boat, if we safe we enjoy our success, if we fail, we all sink down together.

While disjointed transcripts, discussions that few participated in, and low activity levels generally hint at community dysfunction, there are reasons why such indicators need to be properly and carefully considered. As the following discussion indicates, TT teachers did not appear to make up their mind about what topic they would like to investigate in their next PLC. There was some general agreement reflected in postings, but no definitive discussion conclusion. However, at some stage, and not recorded in Moodle, TT teachers decided they would investigate ways of teaching students how to read measurement scales.

A project begins a professional learning conversation by justifying the choice of topic to investigate. It is good to remember what the student learning outcomes are that we are looking for. We should also consider looking at problems that are feasible for us to look at. Some things we cannot change - look at things that we can change. Look at things that are NEW to the group teachers - then everyone has a chance to develop their knowledge and skills.

focus on student's skill in doing measurement i.e reading scale and etc.

Let's find and solve it together.

Student needs to know how to read every single scale coz next time they are able to read the scale correctly even though they are given a different types of scales..so from the task given, we can spot their skill on reading the measurement.
It's a good areas that we can focus on to focus on the problem, because my students do have the same problem...

I think we better investigate on their reading skills, since they got a lot of problem in reading the scales of measuring cylinders and ruler

As the transcript above suggests, when teachers use multiple communication channels (such as Facebook, SMS, and WhatsApp), the Moodle discussion channel may be used for only part of an on-going discussion. As a result, a Moodle discussion transcript may appear disjointed, short on details, and short of participants. A further reason why discussion transcripts might be disjointed and short could be teachers sometimes chose to use Moodle to summarize their discussions that had been completed elsewhere. This might explain why sometimes only one or two people, those charged with entering a discussion summary into Moodle, appear to have participated in many community Moodle discussions, and others who contributed meaningfully are misrepresented with low post frequency distribution statistics and lack of representation in transcripts. This argument may well also be supported by what, on the surface, appears to be a deliberate plan to distribute responsibility for task completion to different individuals in a community.

A review of Moodle discussion posting frequency tables reveals that MA, SA, and IC had levels of participation from all community teachers. Four learning communities (LM, LU, TT, and PD) may possibly have distributed project activities to individual community teachers. The frequency tables of the remaining learning communities are inconclusive. It is important to reemphasize that alternate explanations for distributed project activities exist; that project conversations may have been conducted using alternatives to Moodle, and that Moodle was then used to summarise discussion findings.

The community performance review questions teachers were provided with helped them to understand the strengths and weaknesses of their OLC. However, as the following discussion shows, the language used to ask questions was sometimes difficult for some community teachers to understand:
Commitments to external activity systems (Community) affect project member capacity to participate fully in their community activities (Division of labour due to not able to adjust their time wisely.

i still don't know the meaning

ok ... external activity systems is any other extra program that was used to complete the previous assignment...
donation of labour.
LU-1’s students did the experiment

anyone else has a better idea?

mostly videos and pictures are taken to complete the previous assignment...

i need simple english to understand all of this hahaha...and the questions keep repeating itself i feel.

i am like,"whhhhaaat?" still blank on this,sorry...should it be community as in us and division of labour as in how we all did our task to help to contribute in answering our questions?what tools we use?how we achieve them? was the division of labour fair?biased? How did the community reacted and what happen after that? is all this even correct?haha

Several issues are illuminated by the above discussion, some of which support issues raised in other sections in this report. Firstly, LU-6 appears to be the only teacher to have understood what the focus of this discussion should be. LU-1, LU-3, and LU-5 did not understand what they should be discussing, acknowledged that, and sought clarification from others in the OLC. When LU-5 mentioned not being able to understand the purpose of the discussion, LU-1 tried to help her by posting an interpretation of the project guideline description. However, LU-5 could not understand this guideline.

There are consequences that arise from teachers not understanding the purpose or focus of project discussions. Firstly, any community performance investigation will be flawed
because teachers misinterpreted the community performance questions; and secondly, if a central community figure has a flawed understanding of a discussion topic, she may lead all other community teachers into an irrelevant or off-task discussion. LU-5 has a leadership role in LU, and her views may have carried more weight than the more correct views of LU-6 in this particular case.

Time management has been mentioned previously in this report, and the issue is once more illuminated in the above transcript. LU teachers took all of 10 days to complete the above discussion, and at that rate, LU teachers would surely run out of time long before finishing all the activities required to complete a project. Part of the reason for the discussion taking so long is that LU teachers appeared to rely more heavily on Moodle than other technologies. A review of all LU Moodle discussions reveals that Facebook was never mentioned. This was very different to most other learning communities that quickly discovered teachers did not respond quickly to Moodle discussions. Other learning communities then started using more efficient communication tools, such as Facebook and SMS, to ensure timely communication between community teachers.

Analysis of how teachers used the project completion guidelines illuminated three sub themes (listed in the following table). Firstly, the project completion guidelines were not always followed as intended, and when steps were missed or circumvented, professional learning opportunities were lost for all community teachers. Secondly, some community teachers indicated they found it difficult to understand the focus or purpose of particular community performance discussions, and therefore, the quality of community performance analysis was degraded. Finally, the community needed to find a way to get discussions completed in a timely manner.
Table 31. Project process and procedural challenges

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
<th>Advanced OLC</th>
<th>Developing OLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLC protocol</td>
<td>Effective use of project completion guidelines to complete discussions</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Understand the community</td>
<td>Teachers understand the questions to ask about community performance</td>
<td>Yes</td>
<td>Not all</td>
</tr>
<tr>
<td>performance questions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools</td>
<td>Teachers changed tools to address issues of timeliness</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

6.9.3. Management Style

Two distinct management styles are evident in these results. Successful learning communities adopted a horizontal management style that worked well with the ideas of distributed cognition and collective cognitive responsibility. In horizontally managed learning communities, every teacher had a say in decision-making and every teacher, therefore, had a stake in any outcomes. Less successful learning communities adopted vertical management structures with one or two leaders who drove projects towards completion.

Sometimes, one teacher adopted a leadership role in a top-down management structure. The leader almost always turned out to be the teacher who did most of the work. When this happened, with the best of intentions, the leader inadvertently deprived others in the community of the opportunity to participate in professional learning activities.
Table 32. Community management style characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
<th>Advanced learning community</th>
<th>Developing learning community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consensus decision making</td>
<td>Learning community teachers collectively agree on matters relating to the organisational procedures and practices.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Fairness</td>
<td>Work is seen to be fairly and reasonably distributed given the individual situations and capacities of community teachers.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No designated leadership role</td>
<td>No leadership role as might be found in a hierarchical management structure. Support for a horizontal management structure.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Organizational roles</td>
<td>Roles such as event organizer, planner, and knowledge base librarian are present.</td>
<td>Yes</td>
<td>Few and unevenly distributed</td>
</tr>
</tbody>
</table>

6.10. Teacher Talk

This section describes the ways teachers communicated with each other. In the first of four sub-sections, linguistic code switching is discussed since teachers often chose to use a mixture of Malay, English, and texting language (MalEngTex) to communicate with each other. The second subsection supports an argument that it is counterproductive to require English second language teachers to produce capstone presentations and reports in Standard English. The third subsection discusses the use of multiple communication tools teachers used to participate in project activities. The fourth subsection discusses the importance of a systems approach to conducting project discussions if community teachers are to be able to access the data required to make informed decisions about the professional learning performance of their OLC.

6.10.1. Linguistic Code Switching

Linguistic code switching is the mixing of different languages, often in the same sentence, and is a hallmark of multilingual learning communities throughout the world.
(Reusser, 2001). Project discussion postings are often a mixture of Malay, English, and the shortcut language used in text messages (SMS) and Facebook comments:

**MA-4**

30 March 2011 09:49 A.M.

Students yang ada language problem kali [MA-2]... ngam ka [MA-3]... baik jua buat statistics owh.. good idea..

[Codes substituted for MA teacher names]

The following MalEngTex examples, taken from project discussions from different learning communities illustrate how Standard English, Malay and texting language were combined to form a language for online textual communication:

**TT-3**

14 May 2011 02:12 P.M.

New knowledge and skill..

**TT-3**

14 May 2011 04:24 P.M.

Teaching mathematical skill in science.hehe

**TT-1**

17 May 2011 11:30 A.M.

Ha-ha Kim...banar2. One more thing, ict skill. The use of web resources as their teaching aids.

**TT-4**

17 May 2011 12:54 P.M.

Absolutely... & 100% agree wif kim & zeal, at the end we are not only expert in scientific skills but also maths and ict skills heheh...

**TT-2**

19 May 2011 12:30 P.M.

Wad about thinking skills?? Is it call metacognition?? cos the number like one and one thousand after calculation, does it make sense??

**TT-5**

19 June 2011 04:06 P.M.

Wow! thats sound heavy.. hehehe.. well, i tynk i gained those ICT skill esp frm this moodle where i can chat n share teaching experiences / resources wif other teachers from different school.

**MA-3**

2 March 2011 03:09 P.M.

Kamu marah if your students respond in Malay when you teach in english?
Not all community teachers used MalEngTex; but most did. Three learning communities appear to have made a decision to try to use Standard English throughout project conversations, but perhaps the teachers in these learning communities thought they must publish in English rather than the language they normally use for online discourse when texting or using Facebook. This may be an indication some learning communities were worried that their use of MalEngTex might be perceived to be incorrect. In fact, nothing could be further from the truth. The purpose of the professional development was to encourage in-depth discussion between community teachers, and it is sensible that these discussions should be conducted in the language that is most suitable for that purpose. In this case, MalEngTex was the most widely used and accessible language available to community teachers.
Results presented in this chapter show many TestLed teachers to be very pragmatic about their choices of tools and methods they use to conduct project activities. MalEngTex was used instead of Standard English because it enabled community teachers to communicate with each other effectively and efficiently. Since many community teachers mentioned using Facebook in project activities, it is not surprising that many teachers gravitated towards the use of language they might use in Facebook when interacting with each other online.

6.10.2. Publishing Capstone Reports

It is no doubt possible that capstone reports describe some of what teachers experienced and learned during project activities, but the reality is much of the nuanced meaning present in the transcripts of MalEngTex discussions may be lost in translation when capstone reports are produced. In the case of the LU community, capstone reports were produced by one teacher only, and such reports were likely coloured by this teacher’s interpretations and personal views rather than the negotiated position of her community.

Therefore, at the very least, if capstone reporting is necessary in a professional development programme, then its potential lack of validity needs to be properly recognised, and the use of such reports should be seen as a poor measure of community performance. Put even more strongly, these results suggest the audience for these reports is likely to be Brunei educators who are more familiar with MalEngTex than Standard English, and therefore, it is entirely appropriate that community teachers represent collective knowledge in MalEngTex. Any requirement that these teachers report in academic English and that such reports have some sort of summative assessment value does not appear, in this instance, to serve any useful purpose, and indeed may be counterproductive.

6.10.3. Multiple Communication Modes

This subsection is included for completeness only, as community teachers’ use of a range of communication methods has been widely reported throughout this chapter. To recap, there is strong evidence that SMS and Facebook was used in at least some project activities. They used these tools because they were reliable and likely to elicit timely responses while Moodle contributions were often not responded to.
6.10.4. Choosing Tools Wisely

Results drawn from analysis of project discussions indicate teachers want to have Facebook-like ease of access and SMS-like response times, rather than Moodle-like delays. Community teachers adopted Facebook in an effort to overcome problems they experienced using Moodle alone. Learning communities that used Facebook continued to use it throughout the duration of the TestLed programme, and therefore, it may be assumed the use of Facebook met those community teachers’ needs. The following quotation from an MA discussion provides an insight into this.

MA-3
18 July 2011
08:41 AM

Okay ladies, it’s time to continue what we discussed the other day on Facebook, where we all agreed to investigate on the reasons why the student-centred method of teaching is not yet fully applicable in Brunei schools. We discussed how all of us found that many of our students still heavily rely on teacher's spoon-feeding in order to get ahead in class and their work. We also agreed on investigating the reasons why teachers find student-centred lessons can be difficult to implement.

However, Facebook is not entirely suitable for conducting project activities. Teachers, therefore, needed access to data about how their community performed so they could complete meta-cognitive analysis of their community. Neither Facebook nor SMS provide this data. Additionally, it was not feasible to use Facebook or SMS to maintain a knowledge base, as required in the professional development programme. Therefore, given the paucity of evidence about community performance, teachers could not easily plan for future project activities and could not easily improve their collective knowledge building practices; thereby diminishing their opportunities for professional learning.

The following Ishikawa diagram was produced by LM teachers (using a free online tool) to try to explain why their use of technology in their classrooms did not seem to lead to better achievement of desirable learning outcomes.

Figure 13 succinctly crystallizes the collective knowledge of teachers in a way teachers reported to be more accessible to them than if they relied upon discussion transcripts alone.
Unfortunately, during this time, no community was able to find a single tool or a combination of software tools that was entirely suitable for conducting project activities. While Moodle met most project requirements, teachers in Brunei had difficulty gaining wireless access to the Internet (for laptops), and therefore, often could not gain access to Moodle. SMS was available to teachers, but it is difficult to conduct community discussions this way given its own limitations. Facebook might be marginally better than SMS in the sense that user interface is user-friendlier, but Facebook also has its limitations.

A combination of digital tools could be repurposed so project activities can be conducted effectively and efficiently, but it is important such tools are effective in the specific environment in which teachers conduct their professional development.

**Table 33.** Teacher talk success factors

<table>
<thead>
<tr>
<th>Success factor</th>
<th>Description</th>
<th>High performance</th>
<th>Low performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple communication channels</td>
<td>Use of multiple technologies and software tools including Facebook,</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>SMS, laptops, tablets, and mobile phones</td>
<td>Mostly</td>
<td>No</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>Appropriate use of software tools</td>
<td>Use of software tools in ways that contribute positively towards completion of project activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MalEngTex</td>
<td>Establishment of a community communication language, modes, and norms</td>
<td>Yes</td>
<td>Limited</td>
</tr>
<tr>
<td>Publication</td>
<td>Publication to a wider audience in Standard English</td>
<td>Yes</td>
<td>Limited</td>
</tr>
<tr>
<td>Translation</td>
<td>Translation of MalEngTex to academic English for publication to a larger audience</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>Recording</td>
<td>Recording both tacit and explicit results of discussions and maintaining a record of the processes used to complete project activities</td>
<td>Yes</td>
<td>Some</td>
</tr>
</tbody>
</table>

### 6.11. Cognitive Overloading

This professional development programme was cognitively demanding for teachers from three main perspectives. Firstly, teachers were unfamiliar with the concepts of collective knowledge building and distributed cognition that are embedded in the concept of professional learning learning communities. Secondly, teachers were unfamiliar with the project completion guidelines their OLC was asked to adopt. And thirdly, teachers were asked to adopt a number of software tools they were unfamiliar with in order to complete online collaborative learning activities.

All three issues must be addressed if teachers are to complete project activities successfully, and therefore, teachers may be cognitively challenged by the requirement to learn along several different strands at the same time. If teachers cannot manage their
learning load because they have insufficient time or access to resources, there exists the possibility they may give up and discontinue their collaborative professional learning.

Cognitive overloading occurs when too much learning is expected of teachers given time and resource constraints (Paas, Renkl, & Sweller, 2004). The consequence of individual cognitive overloading is that affected teachers cannot participate fully in community professional learning activities, and this is to the detriment of both the individual and the community as a whole.

6.12. Distributed Cognition

Referring to the first point above, teachers in Brunei were unfamiliar with professional development programmes such as TestLed, where they themselves are responsible for generating professional knowledge. Therefore, it is important for community teachers to learn community-building skills that encourage participation from all teachers.

There is strong evidence in the discussion transcripts of all learning communities that there may well be a “cultural intolerance to open negativity” (Wachob, 2010, p. 357). In this study, SA teachers used the terms agree and agreed 40 times, and did not once use disagree or disagreed in their Moodle discussions. Therefore, each community teacher experienced the tension between the need to develop and support relationships of respect and challenge, and the individual propensity to maintain the particular cultural norms of discourse. That being said, SA teachers recognised the need to form a consensus when different ideas were presented.

SA-2
11 April 2011
10:51 P.M.

My communities really help each other a lot; keep reminding each other to do their part in the PLC, asking and discussing progress or problem arise in the completion of PLC, willing to volunteer, agreed and respect on each other’s constructive ideas or decision-making, keep in touch with each other through e-mail, SMS and Facebook ;)

SA-3
12 April 2011
06:30 P.M.

Time limitation. The project takes time. Sometimes I don't have time to check it again and again since we must connected to the Internet and discuss it online. In addition, it takes time also to agree on 'one decision' as other teachers contribute different ideas.
6.13. Digital Literacies

Teachers needed a degree of digital literacy in order to accurately publish to their project discussions, and so they might accurately interpret the postings of others.

The way teachers communicated in projects is different to the type of comments they use when participating in Facebook or SMS conversations. Discussion participants were expected to build on the discussion comments made by other contributors in ways that advanced the collective professional knowledge of their community.

The MalEngTex idiom was adopted by the teachers to help them communicate effectively and seamlessly across Moodle, SMS, and Facebook; they also had to develop wiki building skills and learn how to import video and static images into discussion postings.

Perhaps the most important digital literacy required of participants was to know which technology was optimal to use in a given situation. Technologies chosen had to be ones that would allow teachers to maintain a record of what was said, and also provide a way to keep track of community professional knowledge (knowledge base).


Of the 53 community teachers who responded to TPACKBRU-Feb, none mentioned having experienced the use of Moodle prior to participation in the TestLed programme. Although they quickly mastered the mechanics of participating in Moodle communication activities, it seems the purpose for each activity was not always fully grasped because of unfamiliarity with the purpose of some generic software application types. In several instances, only a minority of teachers rather than a whole community — as was intended — completed wikis and project discussions. While it was possible for participants to create a Facebook account especially for their community activities, learning how to negotiate meaningfully in Facebook became one more item to add to an already formidable list of other project learning requirements.

Table 34. Learning Load Factors

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
<th>Successful community</th>
<th>Underperforming community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn new software tools</td>
<td>Learn Moodle, Web 2.0 tools, statistics</td>
<td>Yes</td>
<td>No, only a few tools mastered</td>
</tr>
<tr>
<td></td>
<td>packages, etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

148
<table>
<thead>
<tr>
<th>PLC protocol</th>
<th>Learn how to conduct and complete the steps of a project</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project management</td>
<td>Use appropriate planning and project management skills</td>
<td>Yes, some attention to planning to complete work on time</td>
<td>No</td>
</tr>
<tr>
<td>Research skills</td>
<td>Develop capacity to gather and process data, and report results</td>
<td>Some descriptive statistics</td>
<td>Some descriptive statistics</td>
</tr>
<tr>
<td>Parallel processing</td>
<td>Learn how to multitask and parallel process</td>
<td>Yes</td>
<td>Two teachers only</td>
</tr>
</tbody>
</table>

### 6.15. Summary

Whilst these results show different learning communities produced vastly different activity level statistics, they may be broadly grouped into either *very active* or *somewhat active* categories. The learning communities with the highest activity levels are characterized by having at least four active teachers, and within each community, all teachers have similar high posting frequencies. Learning communities with three or fewer teachers were always observed to be somewhat inactive, as were those learning communities that were dominated by one or two members.

Apart from the number of community teachers and their posting frequencies, at least 20 more factors have been identified in this study as impacting on the capacity of learning communities to complete project activities. These factors have been grouped into a consolidated list of five main categories: (1) community leadership, (2) learning load, (3) community management style, (4) Procedures and processes, and (5) Teacher talk. Each of these factors is briefly discussed in the following paragraphs.

The enabling characteristics of a successful community include a minimum of four active teachers participating in a project, that teachers are friends, that they divide labour fairly, that they are organised and have a plan to complete their OLC, and that they actively support their community. On the other hand, teachers have heavy day job commitments as well as home commitments; both of which have a higher priority than professional development; teachers are accustomed to short duration workshops and being told what to do, and hence, professional learning conversations are a new idea to them.
From the cognitive overload perspective, for teachers to successfully complete a project they must know the following:

- How to use a range of software tools including Moodle, Excel, and others.
- What to do at each stage of the project completion guidelines, and what resources needed to be allocated (time and teachers) to complete such processes.
- How to evaluate tools they are using and find new tools that might be more effective.
- How to use project management techniques and practices.
- How to conduct educational research using data processing techniques.

Teachers also need to learn to focus their attention on the learning processes they are participating in rather than on the production of a capstone artefact as they do in traditional Brunei professional development workshops.

Further requirements include:

- Keeping track of multiple communication channels,
- Learning how to understand what other community teachers are saying online (digital literacy), and
- Learning how to elaborate their own position in a language that is understandable to the other participants in their OLC.

From the procedures and processes perspective, members of a community must learn to manage time effectively. They have been accustomed to short duration professional development workshops that require no planning; therefore, they have no experience of participation in long duration professional development activities. This also means they have had no need to develop project management skills.

If project completion guidelines are to be effectively implemented, then possibly the most important component is that teachers must fully understand the rationale behind working in learning communities for professional development. Sometimes completion of a protocol becomes an end in itself, instead of it being a guide to facilitate completion of a project (Earl & Timperley, 2009b).
Community members needed to convey ideas to each other clearly and in a timely manner if they were to complete project activities successfully. One of the challenges faced by teachers was there was often insufficient bandwidth in their schools for them to go online with members of their community. Teachers addressed this challenge by using multiple communication channels and technologies. They used Facebook and SMS instead of Moodle alone; they used tablets and mobile phones as well as school computers; and they connected to the Internet with their own devices. Additionally, participants overcame language barriers and digital literacy issues by supporting an online language that was common to all of them. This language is a mixture of texting, Malay, and casual English (MalEngTex), and was the language most research participants chose to use in a Facebook setting.

The ways teachers chose to talk to each other both enabled and hindered completion of project activities. While the use of mobile devices and a range of communication channels overcame communication issues such as a lack of response, the use of these tools deprived community teachers of both a knowledge base and a record of the processes they went through to acquire the knowledge.

The use of MalEngTex is viewed by the researcher as an enabler of project discussions as it plays a part in helping teachers to properly convey what they want to say to fellow community teachers, overcomes language barriers faced by English additional language teachers, levels the playing field when some community teachers speak English more fluently than others, and provides teachers with some degree of confidence in participating in project discussions. Mitigating the value of MalEngTex language was the requirement that learning communities produce capstone reports in English to be shared with a broader public audience. This involved translating, with some degree of difficulty — and probably not completely accurately — the well-understood tacit and explicit knowledge of their community into Standard English.

These results suggest to the researcher, given that the audience for reports is likely to be Brunei educators, that the use of MalEngTex may well be appropriate. MalEngTex is well understood both within learning communities and amongst teachers of a wider educator audience; therefore, it is in the interests of all stakeholders that MalEngTex not be widely discounted.
These results indicate that teachers might feel cognitively overloaded by the amount they are required to learn to complete project activities. The solution to this challenge may lie in providing teachers with the means to learn and the time to practice their newfound skills and knowledge in a fully supportive professional learning environment. To this end, teachers may benefit from being immersed in projects repeatedly over an extended period of time.

With the above results in mind, the following community enablers and challenges have been listed so that a high performing OLC may be contrasted with a underperforming OLC.

This chapter shows there is no single approach to professional development that will guarantee a community will be successful. Each OLC had its’ own developmental trajectory and developmental requirements. And yet, each and every community needs to be successful as the cost of failure is that all community teachers miss the opportunity to learn professionally.

A number of characteristics found in top performing learning communities have not been found in less successful learning communities. This is not to say that the learning performance of a community is limited, but rather, there are organisational and procedural challenges that, when overcome, give teachers a better chance to be successful learners. No characteristics of top performing learning communities were found in this study that would be impossible or difficult to replicate in other learning communities. However, it necessary to clearly identify the success factors that may be absent from underperforming learning communities and then identify strategies to remedy them.
Chapter 7. Case Study Analysis of the MA and LU learning communities

7.1. Introduction

Chapter 7 presents the findings of case study analyses of a successful learning community called MA, and an underperforming community the MA group, and a less successful community, the LU group. By highlighting the similarities and differences between the MA and LU results, it may be possible to gain insights into community characteristics, procedures, and processes that support, sustain, and enable online, collaborative, professional learning.

This chapter is the last of the three results chapters; Chapter 5 presented the results of analysis of the TPACKBRU questionnaire; Chapter 6 presented the results of analysis of network server logs. The findings of this chapter are discussed in Chapter 8.

7.2. Selection of MA and LU for Case Study Analysis

MA and LU were selected because they were quite different from each other. MA was a successful learning community that had well developed processes for knowledge production and representation, while LU was an underperforming learning community. As mentioned previously, there is more to be gained from comparing and contrasting two different communities than there is from analysing two communities that were similar (Yin, 2009). Every community in the study was analysed at the end of the professional development programme before MA and LU were chosen for indepth case study analysis (see Appendix F and Appendix I for quantitative analysis results for each community). A comparison between MA and LU shows that MA was considerably more active than LU. For example, MA teachers collectively contributed 428 discussion postings (Table 35), the highest number of postings of any community (ranked first out of all communities). MA teachers produced a median number of postings of 112, which was the highest of any community. It is also important to observe that MA had the highest ranking for wiki production activities, as this was the second of the two major knowledge production activities.

Table 35. MA rankings analysis
<table>
<thead>
<tr>
<th>Activity</th>
<th>LC total</th>
<th>LC rank</th>
<th>Median</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>255</td>
<td>2</td>
<td>66</td>
<td>3</td>
</tr>
<tr>
<td>Chat view</td>
<td>24</td>
<td>9</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>111</td>
<td>5</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>Forum add post</td>
<td>428</td>
<td>1</td>
<td>112</td>
<td>1</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>1439</td>
<td>2</td>
<td>370</td>
<td>2</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>306</td>
<td>1</td>
<td>74.5</td>
<td>1</td>
</tr>
<tr>
<td>Wiki view</td>
<td>1230</td>
<td>1</td>
<td>317</td>
<td>1</td>
</tr>
<tr>
<td>Wiki view all</td>
<td>32</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

On the other hand, LU teachers contributed to discussions and wikis far less frequently than other communities (Table 36). What is especially telling in the following table is that the median number of wiki contributions was 0.5, an indication that teachers in this community did not use their wiki to negotiate a shared description of the knowledge they were able to discover during their project activities. In addition, given the differences between learning community rankings (LU rank) and the average ranking when all teachers in LU were compared to all other teachers in the study, it was clear that only one or two LU teachers were making the vast majority of contributions to knowledge production activities.

Table 36. LU rankings analysis

<table>
<thead>
<tr>
<th>Activity</th>
<th>LC total</th>
<th>LC rank</th>
<th>Median</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>112</td>
<td>9</td>
<td>20.5</td>
<td>8</td>
</tr>
<tr>
<td>Chat view</td>
<td>60</td>
<td>4</td>
<td>9.5</td>
<td>5</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>122</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Forum add post</td>
<td>284</td>
<td>5</td>
<td>31</td>
<td>8</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>1173</td>
<td>5</td>
<td>120</td>
<td>5</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>129</td>
<td>4</td>
<td>0.5</td>
<td>9</td>
</tr>
<tr>
<td>Wiki view</td>
<td>784</td>
<td>4</td>
<td>42.5</td>
<td>8</td>
</tr>
<tr>
<td>Wiki view all</td>
<td>23</td>
<td>7</td>
<td>2.5</td>
<td>9</td>
</tr>
</tbody>
</table>
The results of analysis of web tracking statistics were supported by some content analysis of all communities with Atlas Ti, as indicated throughout chapter six. This initial analysis, and observations during sharing sessions and workshops, led the researcher to believe that the LU community was struggling with many of the then emerging issues raised in Appendix H. On this basis LU and MA were selected as a very good combination of communities for further in-depth case study analysis.

7.3. MA Analysis Procedures

The data used for analysis of the MA group came from multiple sources. Firstly, project discussion transcripts were analysed to determine what MA teachers said and to provide MA communication patterns. Secondly, TPACKBRU questionnaire responses supplied valuable information about the demographics and experiences of MA teachers. Thirdly, community performance reports provided both the perceptions of MA teachers about their capacity to complete project activities effectively, and an indication of how MA teachers analysed their own professional learning performances. Project investigation reports illuminated how MA teachers were able to manage community workloads and applied the project completion guidelines successfully. Field notes, taken during professional development workshop sessions, recorded MA teacher learning characteristics. Workshop attendance records provided evidence of committed teachers who overcame challenges to meet face-to-face with their OLC. Finally, teachers produced artefacts such as scanned images, video, PowerPoint presentations, and audio recordings, the analysis of which provided a further opportunity to understand how MA teachers completed project activities.

7.4. MA Demographics

The four female teachers in MA were close friends. They went through their degree programmes and teacher training at The University of Brunei together and have continued their association in the years of teaching that followed. At the time of the TestLed programme, MA-4 was 26 years old and the other three teachers were 27 years old. They all teach general science (to Year 7 students, and no two teachers were teaching in the same school).

The following table (Table 37) summarises some of the characteristics of MA teachers. All MA teachers were familiar with communication technologies such as Facebook.
However, none of these teachers were familiar with using electronic communication for collaborative professional learning, since none indicated they had experiences of learning collaboratively rather than independently.

Table 37. MA teacher characteristics

<table>
<thead>
<tr>
<th>LC Teacher / Characteristic</th>
<th>MA-1</th>
<th>MA-2</th>
<th>MA-3</th>
<th>MA-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years at time of study</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Female</td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td>Began teaching</td>
<td>2009</td>
<td>2009</td>
<td>2009</td>
<td>2009</td>
</tr>
<tr>
<td>Own a laptop</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Use computers for work preparation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Have a Facebook account</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Collaborative learning experiences</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

7.5. MA Moodle Server Log Analysis

The results presented in the following table (Table 38) reveal the levels of participation of individual MA teachers. These results show that collectively, MA teachers participated in numerous online activities during their professional development programme. They produced more forum discussion posts (n = 428) than any other OLC, the highest levels of wiki development activity, and third highest level of chat activity. The small interquartile range of 18.5 for the MA posting frequency distribution reveals that all MA teachers made similar numbers of discussion postings throughout the TestLed programme.

Table 38. Online activity statistics for MA

<table>
<thead>
<tr>
<th>Activity</th>
<th>MA-1</th>
<th>MA-2</th>
<th>MA-3</th>
<th>MA-4</th>
<th>Med</th>
<th>LQ</th>
<th>UQ</th>
<th>IQR</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>57</td>
<td>75</td>
<td>46</td>
<td>77</td>
<td>66</td>
<td>48.75</td>
<td>76.5</td>
<td>27.75</td>
<td>77</td>
<td>46</td>
</tr>
<tr>
<td>Chat view</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>3.75</td>
<td>8.25</td>
<td>4.5</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>35</td>
<td>2</td>
<td>7</td>
<td>67</td>
<td>21</td>
<td>3.25</td>
<td>59</td>
<td>55.75</td>
<td>67</td>
<td>2</td>
</tr>
<tr>
<td>Forum add post</td>
<td>111</td>
<td>113</td>
<td>114</td>
<td>90</td>
<td>112</td>
<td>95.25</td>
<td>113.75</td>
<td>18.5</td>
<td>114</td>
<td>90</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>423</td>
<td>360</td>
<td>380</td>
<td>276</td>
<td>370</td>
<td>297</td>
<td>412.25</td>
<td>115.25</td>
<td>423</td>
<td>276</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>141</td>
<td>50</td>
<td>99</td>
<td>16</td>
<td>74.5</td>
<td>24.5</td>
<td>130.5</td>
<td>106</td>
<td>141</td>
<td>16</td>
</tr>
<tr>
<td>Wiki view</td>
<td>530</td>
<td>174</td>
<td>460</td>
<td>66</td>
<td>317</td>
<td>93</td>
<td>512.5</td>
<td>419.5</td>
<td>530</td>
<td>66</td>
</tr>
</tbody>
</table>
MA teachers participated regularly in project activities that were likely to lead to collective professional learning. The activities likely to advance professional knowledge were those that promoted interaction between teachers (DuFour et al., 2008; Louis & Marks, 1998; Salmon, 2005). Each teacher made numerous contributions to project discussions, wiki building activities, and project investigations.

The results shown in Table 39 reveal that MA teachers were not only active online, but also more active than most other learning communities in nearly all categories. MA teachers had the highest number of discussion postings of any community in the study (ranking position first out of 10 learning communities), and also had the highest number of wiki additions.

Based on observed and recorded interaction levels, it is reasonable to say that MA teachers had advanced past the coalescing stage of a CoP life cycle (Wenger et al., 2002). From the professional learning community perspective, these results, when triangulated with the results of transcript analysis, show MA teachers have established common goals and a collective commitment to sustain their community (Richard Dufour et al., 2008).
### Table 39. MA Moodle activity rankings

<table>
<thead>
<tr>
<th>Activity</th>
<th>LC totals</th>
<th>LC rank</th>
<th>Median</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>255</td>
<td>2</td>
<td>66</td>
<td>3</td>
</tr>
<tr>
<td>Chat view</td>
<td>24</td>
<td>9</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>111</td>
<td>5</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>Forum add post</td>
<td>428</td>
<td>1</td>
<td>112</td>
<td>1</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>1439</td>
<td>2</td>
<td>370</td>
<td>2</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>306</td>
<td>1</td>
<td>74.5</td>
<td>1</td>
</tr>
<tr>
<td>Wiki view</td>
<td>1230</td>
<td>1</td>
<td>317</td>
<td>1</td>
</tr>
<tr>
<td>Wiki view all</td>
<td>32</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

#### 7.6. Values of MA Teachers

MA teachers mentioned friendship, trust, and fairness as individual values they aspire to. The remainder of this subsection presents the results of an investigation of why MA teachers thought friendship, trust, and fairness were values that helped them to achieve professional learning goals during their TestLed programme.

#### 7.6.1. MA Friendships

MA teachers had been friends for several years. They were friends at university and have been friends ever since. Therefore, the MA teachers were sure to have known each other for at least the six years immediately before the TestLed programme began in 2011. All MA teachers went through the same University of Brunei education degree programme at the same time, and all had been teaching for two years before beginning TestLed. The following MA performance report excerpt highlights the value MA teachers place on friendship, and how it influenced their ability to sustain their OLC.
The good thing about our group is that all of us are already friends from university so therefore we have known each other for quite some time now and maybe this is one of the reasons why we work well with each other even though all of us are pressed for time to complete our tasks in this group.

Analysis of MA project discussion transcripts showed the MA teachers had good communication skills and high activity levels from the very beginning of TestLed. This interaction also showed the MA teachers were committed to participating in their OLC.

According to CoP theory, teachers who are new to a community must go through an acceptance/initiation process during which they develop credibility, social skills, and knowledge of how to communicate in their CoP setting that enables them to fully participate with others in their community (Lave & Wenger, 1991). There is strong support for an argument that MA teachers had advanced past the potential and coalescing stages of CoP development (Wenger et al., 2002) even before their professional development programme began. These teachers were friends with similar professional interests, values, and experiences, and they had the means to communicate effectively before TestLed began. All MA teachers used Facebook to communicate with their MA friends. They, therefore, have had experience communicating with each other online and sufficient time to develop the operational procedures and language skills required for effective online collaborative professional learning communication.

That being so, the MA teachers may have quickly and easily moved onto the more productive maturing and stewardship phases of CoP theory as TestLed began, and were, therefore, able to realise the rewards of early project activities. This contrasted with teachers in other learning communities who were still trying to develop their groups to a point where there was a common focus and purpose for their OLC, as well as determine the means to communicate so they could conduct project activities.
7.6.2. MA Trusting Relationships

MA teachers trust each other. This trust may have extended to relationships of respect and challenge that, according to (Earl & Timperley, 2009a), are required to support co-construction of professional knowledge.

MA trusters trust each other. This trust may have extended to relationships of respect and challenge that, according to (Earl & Timperley, 2009a), are required to support co-construction of professional knowledge.

Although MA teachers trusted each other, and had excellent communication skills, these attributes were insufficient to support completion of project activities in ways that met or exceeded MA teachers’ professional learning objectives. These teachers needed to put in place practical procedures and processes to ensure they could meet or exceed their professional learning expectations.

7.6.3. MA Teachers Valued Fairness

MA teacher actions supported an argument that they made collective decisions about community procedures that were underpinned by belief in the concepts of collective responsibility for project progress, and the concept of fairness to others. These teachers regarded a fair distribution of labour as a useful supporting strategy for completing project activities.

Silent partners were teachers who failed to participate in project activities. Results indicate that MA teachers were unwilling to become silent partners for fear of letting down their friends. At the same time, MA teachers evaluated the performances of others in their OLC, which indicated they were self-regulating the behaviour of their OLC, even though they explicitly distanced themselves from the idea of rule setting.
Session 11 MA Learning
Community Performance
Report Extract

We always remind each other and all teachers take part in all discussions equally and to avoid any sleeping partners. However, we always do it on the last minute due to our commitments on more other important tasks in school and also make time for family.

There were indications that individual MA teachers put team goals ahead of personal goals during TestLed. This is an indication of the strength of the bond between the MA teachers, and an indication of the importance of the strong ethical position adopted by each individual.

7.7. MA Teacher Predispositions

It was necessary for teachers to adopt an unfamiliar approach to professional development to complete project activities. Generally, at the time of the study, teachers in Brunei were familiar with short duration professional development workshops during which they learned content and skills from an instructor. This is what is meant by the term traditional PD in the Brunei sense. Teachers were not accustomed to co-constructing professional knowledge, and were more often than not passive receptors of transmitted knowledge. The teachers in the MA group were able to adopt a co-constructivist approach to professional development. They wanted effective professional development that was designed to improve student-learning outcomes. No negative individual dispositions towards community based professional development were found amongst MA teachers’ transcripts and reports.

The MA teachers supported the TestLed approach to professional development, but also recognised that this was new and different to anything that Brunei teachers had previously experienced. They also recognised many Brunei teachers might be more comfortable with traditional workshops than professional development in a community.

MA performance report extract 1

We feel comfortable working and sharing knowledge provided the knowledge is fun and interesting and it does not require too many workloads.
MA performance report extract 2

We enjoy building and sharing knowledge with other teachers. It may not benefit me immediately but I know that one day it will be of great use. Traditional workshop based PD may not have a great impact/outcome.

MA performance report extract 3

We think they are as long as the tasks that they have to do are easy to understand and follow. But we also believe that most teachers prefer traditional PD because they are taking a more passive role in the PD as some teachers are shy and reluctant to speak their mind.

7.8. MA Teacher Workplace Context

MA teachers recognised the tension between institutional educational expectations and the professional learning outcomes associated with the TestLed Programme. In the following example, MA-2 explains how new teaching methods learned during professional development programmes might not be implemented because the school was focused on examination performance ahead of all else — in which case, advanced pedagogical practices were of little use.

MA-2
Tuesday, 19 July 2011
06:45 P.M.

i agree, result does matter and what we want to see is only good results. teachers were trained with so many teaching methods but yet if results are not good, we will be back to square one and we end up with give up in adapting the new PD methods.

These teachers felt they needed to teach to the examination. They were concerned the Ministry of Education and school administrators used examination performances to measure their professional performance.
Every school will look into results at the end of the day. From the results teachers and students were judged according to their performance in school. And of course what we want to see is only good results. Teachers were trained with so many teaching methods but yet if results are not good, we will be back at square one and we end up with giving up trying to adapt to the new PD methods. A teacher should choose the correct and fun teaching method so that student having fun and looking forward to study/coming to school.

Therefore, it was important to the MA teachers that there was an explicit link between professional development activities and student learning performance gains in their own classrooms. In terms of project theory, it was, therefore, important that project results led to short-term goals that were properly calibrated, and not just long-term goals that might be realised at some (unspecified) time in the future (Richard Dufour et al., 2008).

7.9. MA Processes and Procedures

This section describes the different processes and procedures that MA teachers used during their project activities. The following paragraphs show how MA teachers were able to recognise problems in their learning community and change processes and procedures to improve collaborative professional learning performances.

7.10. MA Project Management Activities

MA teachers undertook many activities, both online and offline, to complete a project. When project activities were carefully prepared, plans were successfully implemented and appropriate amounts of time were allocated to professional learning activities. When time, resources, and people were insufficient, opportunities for professional learning were lost. A search of all MA performance reports using time as a search string (using Atlas Ti software) revealed that time issues were mentioned by MA teachers 100 times. Similar searches of project discussion transcripts show time issues were mentioned in 322 discussion postings. Therefore, it is reasonable to infer that MA teachers regarded organising their project processes and procedures (project management) as perhaps the most significant challenge they faced.
Although MA teachers recognised they had project management challenges, they did not find ways to satisfactorily overcome these. The following discussion excerpt between MA-1 and MA-2 illustrates this situation.

20 June 2011, 10:02 A.M.
MA-1

*It is hard to conduct this project because time constraints are a major issue. Then, schoolwork gets in the way and we are unable to efficiently do the project properly.*

20 June 2011
01:56 P.M.
MA-2

*we are unable to sit together and set time to complete our investigation due to school holiday, school works, BCATs and other responsibilities*

The following quotation is from a self-generated MA performance report that was completed in May 2011. It reveals teachers recognised they were not managing time effectively, and they relied entirely on the good will of each MA teacher to complete tasks.

MA Learning Community Performance Report Extract – May 2011

*As a conclusion to this group performance report, our group have done the investigation report a bit behind from the other TestLed A communities but our group are able to do it with pure determination and co-operation from all of the group teachers even though our group did not implement any rules and has difficulties managing our time well and prioritising as well as we should have.*

MA teachers never really overcame time management challenges. In their final report (September 2011) they said, “PLC teachers did have a plan but did not have enough time to implement them.” According to Richard Dufour et al. (2008), “without credible communication, and a lot of it, change efforts are doomed to fail” (p. 99). Therefore, it is necessary that teachers employ strategies to ensure sufficient time is made available for in-depth discussions.

**7.11. MA Use of the Project Completion Guidelines**

As mentioned earlier, the project completion guidelines introduced in TestLed had two parts. In the first one, teachers followed guidelines for completing the investigation of a teaching problem. In the second part, teachers followed guidelines for investigating how their community performed. MA teachers completed project activities effectively; however, they did not have access to all the data they needed to make informed decisions
about community performance, and unless they used Moodle, they did not have a comprehensive record of their communication. Perhaps, because MA teachers chose communications channels that prevented them from reliably analysing community performance, they were unable to gain professional knowledge they could use to improve the effectiveness and efficiency of their OLC.

7.12. MA Management Style

MA teachers adopted a horizontal management structure rather than having a leader to direct completion of project activities. They made decisions as a group. The following telling discussion posting was produced late on a Saturday night in September 2011. It, therefore, represents the position MA teachers finally reached after working together for many months.

MA-1
10 September 2011
11:28 P.M.

In our group, all of us did all of the work because it is fairer to do things this way and our group did not have any leaders. We always remind each other about completing the tasks/discussion questions and this has worked for us before and we will continue to do this in the future.

MA teachers did distribute tasks amongst their group so as to effectively complete project activities. The following wiki transcript extract illuminates some of the important characteristics of how MA teachers managed their OLC.

MA-1
10 September 2011
11:04 P.M.

Looking back on previous investigations, we always had one person who we refuse to label as the 'leader' but we choose to call 'the initiator'. This person's task is to rally everyone and inform the others of the 'must-do's of the investigation. and also, the last person to complete everything needs to upload Wiki and report. We did not hav any rules and a leader. We hav d initiative of a member to start the forum, n reminds evryone to complete before the next session.
All teachers took part in MA decision-making processes rather than having a single leader who dictated to others. MA teachers relied on individual good will to get project tasks allocated and completed.

MA-1
10 September 2011
11:04 P.M.

We trust that each of us will contribute equally to the task in hand and therefore complete it in time.

There were indications that before the beginning of the first project, MA teachers had an aversion to rules that might govern the behaviour of teachers. The following comment made by MA-4 showed that MA-4 believed that rules might be counterproductive.

MA-4
19 July 2011
02:38 P.M.

No rules r actually set hence nothing prevent good collaboration. Only efforts are needed to create such collaboration to happen.

Although MA teachers mentioned not wanting rules, they still had expectations of what teachers should say and do. These teachers recognised the need for rules and also the need to monitor rules’ compliance. The following MA wiki transcript describes how this community believed rules and project management were the two biggest challenges they faced when completing project activities.
This time around, we decided on a topic around approximately two weeks before the deadline of the report and hence everything was rushed to the last minute. Again, Facebook has been the mode of all of our conversations. The drawback of our project was that it was not started earlier as we should have. Problem to be investigated was made 2 weeks back unfortunately again we did it last minute. as usual discussion were made through facebook Discussions were made much earlier but through Facebook, since it was more accessible to some of us. Nonetheless we realised that our initial discussions should have been conducted through Moodle since it acts as evidence as to how the topic of investigation was decided on. And also, even though discussions and decisions were agreed on weeks ago, starting the investigation was delayed. For our group, having all of us to discuss in a conversation at the same time is difficult. We tend to leave comments in facebook, instead of using chat in Moodle. We always wanted to start early but always tend to have it done in the very last minute. I think, for the next project to be a lot better, rules and time need to be strictly scheduled, for the best of us.

Towards the end of the TestLed programme, teachers changed their view about the need for rules. They went from viewing rules as counterproductive to viewing them as necessary to ensure teachers completed tasks on time.

On the down side, no rules also got us to where we are today – a little bit behind the other communities.

They finally decided on a single rule that encouraged participation in project activities in a timely manner. This rule was that the teacher who was last to participate in project activities was responsible for producing the project investigation and community performance reports. The following report extract shows how MA teachers applied one rule to ensure teachers completed activities in a timely manner.
Our group does not have a specific rule but we have always followed the rule where we complete everything but the very last person to complete all of the discussions & wiki will be doing the report. It has helped our group to complete all of our tasks so far and hopefully this rule will continue to help us in any of our future tasks. Discussions would have been better with rules but we still discussed through Facebook because it was more convenient. No rules were set except for our golden rule where the last person will be the one to complete to wiki and reports.

MA-3 wrote most of the MA reports, and therefore, was the person least likely to complete activities on time. Apparently, the rule designed to encourage timely participation in project activities did not really work since MA-3 continued to be last to participate in project activities throughout the TestLed programme. That being said, the existence of the rule showed that MA was interested in solving their project management issues.

According to Engeström (1999), Cultural Historical Activity theory suggests there will be tensions between a rules node and a subjects node, and this was clearly the case for MA teachers. These teachers (subjects) struggled to reconcile a collective aversion to rules with the need for rules and leadership to support project productivity aims. At the same time, MA teachers realised rules could stifle the creativity required for the professional knowledge building at the heart of their professional development programme.

The experiences of MA teachers in this regard suggest that good will, dedication, and a common community focus are important, but that planning skills are entirely necessary. In the absence of planning, teachers were forced to resort to compressing or excluding project activities because they ran out of time that would otherwise have provided good professional learning opportunities.

However, in defence of the MA group teachers, no matter how pressed for time these excellent Brunei teachers were, their results show they did put time and effort into their discussion responses and other project activities. Perhaps with better project management, the MA teachers would have felt less pressure to complete a lot of tasks in a short amount of time, and their community performances would have been even better.
In summary, MA teachers never managed to overcome time management challenges. They did make plans to complete project activities, but failed to implement their plans successfully.

If these teachers had access to a digital footprint of their project activities (such as Moodle server logs, network metrics, or discussion transcripts), they would have been able to refer back to records of previous project activities to estimate the duration of activities in the next PLC. They would also have had access to the data that might indicate the extent to which their strategies for improving community efficiency were effective.

Some of the tools MA teachers used for communication did not provide a digital footprint; therefore, if teachers had wanted to improve community efficiency by considering past community performances, they would not have been able to.

The next subsection shows how MA teachers successfully and creatively overcame communication challenges so they could engage fully in project activities. At the same time, it shows that by improving communication they reduced their capacity to improve community efficiency. The trade-off was project activities were completed because multiple communication channels were used, but community performance efficiency did not improve over time because MA teachers did not have a way to evaluate the extent to which community performance improvement strategies had worked.

7.13. MA Teacher Talk

This section presents the results that show how MA teachers communicated with each other during project activities. It describes the language they used, their choice of language for different scenarios, and the tools they selected for different communication purposes.

CoP theory suggests learning communities develop their own ways of representing knowledge and their own protocols for community interaction (Lave & Wenger, 1991). Project theory further states there will be a lot of communication between teachers if professional learning is to take place (Richard Dufour et al., 2008). Therefore, in the context of this study, it is worthwhile to consider how and why MA teachers
communicate the way they do. This next subsection describes the language teachers used to talk to each other — and the reasons why they used it.

### 7.13.1. MA use of Linguistic Code Switching

Linguistic code switching and MalEngTex were introduced in Chapter 6 as a way for teachers to effectively and comfortably communicate with each other. The following MA discussion transcript highlights a number of the features of MA teacher discourse that were present in the transcripts of MA discussions, wikis, and chat sessions. The MA version of MalEngTex was a colloquial language characterized by the use of Malay words and phrases mixed in with English words. Some words and phrases were coded (both Malay and English), some shortened, and some phrases were unique to an online mode of communication. The use of terms like *hmm, kinda* and *so guys* make MA conversations more colloquial than Standard English conversations. Such language may have made the project discussion environment less daunting to those participants who were not confident about the standard of their English. It was also possible that participants were able to clearly explain their views in MalEngTex, and found it more difficult to do the same in Standard English. Additionally, these teachers were familiar with MalEngTex because they used it in their everyday Facebook discussions. These are all good reasons for letting learning communities develop their own ways of communicating rather than imposing a requirement that Standard English be used.

**MA-1**  
19 March 2011  
02:45 P.M.  

*I think all of us have the same ideas on how our students have difficulties using English and from the third question in our forum, we kinda can sum it up as, the evidence where language is a barrier to most of our students are:  
1. Unable to answer in full sentences  
2. Make spelling mistakes  
3. Make grammar mistakes when answering questions  
4. Unable to answer questions in English orally  
5. Unable to read and understand the question independently  
6. Have difficulties understanding simple instructions  
7. Have problems communicating with the teacher in English  
That's what I can think of for now..*

**MA-3**  
20 March 2011  
08:24 P.M.  

*Numbers? *hmm. I see how that would help. so guys, when school re-opens this monday, shall we all do a rough count? Im taking my Year 8A and Year 8F as samples. I have 28 in 8A and 32 in 8F.*
what do we do? count apa? hehe what problem are we focusing?

Students yang ada language problem kali ernie.. ngam ka nurul.. baik juba buat statistics own.. good idea.. [I agree with MA-2 and MA-3 that we need statistics to show that students have a language problem]

Yes we should make statistics for each of the focused problems that we want to address, which are grammatical errors, inability to answer questions & spelling errors. So to do this, we are going to analyse & tally the errors & translate the results into bar graph form

Postings such as “Students yang ada language problem kali ernie.. ngam ka nurul.. baik juba buat statistics owh.. good idea.. ” require knowledge of MalEngTex as translation into either Malay or English results in a collection of disconnected, part-sentences that do not seem to be related or make any sense. The English translation in the discussion transcript shows some of the intent of the posting, but does not convey the weight of different points — or the affective dimension of the posting. Something has been lost in the translation.

MalEngTex was accessible to all MA teachers since they all have experience using it. MalEngTex may be used whether texting on a mobile phone, chatting synchronously, in Facebook, or in Moodle discussions. Therefore, MA teachers only needed to know one language to be able to participate in project activities.

It is reasonable to infer that MA teachers preferred to use MalEngTex rather than Standard English, as they continued to use it throughout the nine months of their professional development programme.

7.13.2. MA Production of project Reports

MA teachers were required to write project reports at the end of their investigations. The reports produced by MA teachers were in Standard English, which suggests these teachers decided to code switch during project discussions, but then wrote up discussion summaries (teaching and learning investigation reports) in Standard English. There is an argument, however, that the knowledge base of a community needs to be accurate, and that in the process of translating from MalEngTex discussion threads and wiki pages into Standard English PLC, some nuanced understandings would be lost. This argument is further supported by results that show reports produced by the MA group, although
comprehensive and well written, were not as rich in information and detail as the discussions from whence they were translated and condensed.

7.13.3. MA Use of Multiple Communication Channels

There is ample inferential evidence (and MA teacher admissions) that teachers used communication channels other than Moodle when participating in project discussions. This means that Moodle discussion transcripts were not always a complete record of online project activity. As mentioned earlier in this section, MA teachers were used to communicating online in a social setting, so it is not surprising they should chose to do this when they found it difficult to conduct discussions in Moodle.

As for other people, the easiest way to maintain the community is to have each other in FB or frequent meet ups with one another.

MA teachers stated that the Moodle communication tools they were provided with were easy to use, but they still preferred the tools they were most familiar with. The following community performance report excerpt suggests that communicating through Facebook was the most popular form of communication for these teachers.

All of the tools that we have are useful in our project but the time to use it is not always there. Most of the new tools such as chats, forums and wikis are useful and easy to use however we are more fond of communicating through Facebook.

7.13.4. MA Tool Usage and Consequences

TPACKBRU questionnaire responses show that, on occasion, a small number of teachers could not access Moodle because they did not have reliable wireless access to the Internet in their school. When this happened, teachers switched to alternative means of communicating, which included the use of texting with a mobile phone. Most commonly, when Internet access was not available, teachers used their mobile phone as an Internet access point. The phone was then connected wirelessly to a tablet PC or laptop to provide access to Moodle.
This access method via mobile phone was used frequently in Brunei schools at the time of this study because of the limited Internet access there, and makes it reasonable to say that community teachers had a way to overcome Moodle access issues if they wanted to.

As mentioned earlier, MA teachers wanted to use tools they were familiar with and that they felt might enable them to communicate more effectively. Participants found it more efficient to use Facebook for everyday communications; when more urgent responses were required, they sent text messages to each other.

These Moodle alternatives were used by MA teachers for a number of reasons:

1. Teachers already knew how to SMS and send messages using Facebook, so there was no need to learn a new technology (Moodle);
2. Teachers found that Moodle discussion responses took too long to complete;
3. The Moodle login process to check for discussion updates was time consuming to perform compared to logging into Facebook;
4. Moodle was not easy to use on small screen devices such as mobile phones and tablets; and
5. Using Facebook and texting was attractive because it was less like work and more like social networking.

A Moodle application for smart phones and tablets was released on 1 July 2011 (Moodle docs, 2012). However, none of the teachers in this study knew about this application and did not use it. The development of Moodle apps for tablets and mobile phones is ongoing, and the use of these tools may overcome some of the communication difficulties TestLed teachers experienced in 2011.

### 7.13.5. MA Collective Cognitive Responsibility

The concept of collective cognitive responsibility is that teachers share responsibility for the collective professional knowledge of their community (Angeli, 2008). All teachers of the MA group participated in the development of new MA professional knowledge through wiki development and participation in discussions, and therefore, shared in the development of professional knowledge. By doing this, MA teachers maximised their professional learning by being able to draw on the knowledge, dispositions, and experiences of all teachers during project activities.
The risk, when teachers were provided with a protocol such as the project, was that rather than the professional learning that takes place at each step of the protocol, completion of the steps of the protocol would become the end. This was particularly so when project activities were of fixed duration and learning communities were running out of time.

MA Session 3 Learning Performance Report Extract compiled by MA-3

One rule which we did follow was that each member was required to reply at least once to the forum and discussion so each of us is actually having the same workload. Teachers would be welcome to add on and more comments to the discussion but due to the time constraint, elaborating the discussions was not an option for any of us.

MA teachers did share collective cognitive responsibility for professional learning, but this might have been even more successful had teachers been able to overcome some of the time management challenges they faced. When MA teachers failed to manage time well, collective, cognitive responsibility was supplanted by procedural compliance to produce project capstone reports. Teachers needed the time to be able to participate in community activities, and this, quite simply, was not there.

The communication tools community teachers used to communicate with each other determined to some extent how they were able to co-construct new professional knowledge. The next subsection discusses the tools MA teachers chose to use, and the extent to which those choices supported professional learning goals.

7.13.6. MA Use of New Software Tools

This section begins with analysis of a transcript taken from a project discussion near the beginning of the professional development programme. Some of the discussion postings show that initially MA teachers were unfamiliar with Moodle, and therefore, needed to learn how to use Moodle tools before being able to participate in project activities. MA teachers learned how to conduct discussions in Moodle within an hour or two. The following project discussion transcript highlights how MA teachers experimented with, and then quickly adopted, Moodle.

MA discussion: “What problem are we going to investigate” started 2 March 2011
A community begins a professional learning conversation by justifying the choice of topic to investigate. It is good to remember what the student learning outcomes are that we are looking for. We develop their knowledge and skills.

Language

Language used in classrooms

Testing

why did i not receive tine’s reply?

Testinggggg

Kama marsh if your students respond in Malay when you teach in English?

nda juba.. but drg wudnt answer in english.

we need to look at things that we can change.. can language be changed?

how about looking at lab skills n techniques?

I'm getting confused

we can change they way they speak English...meaning, we might need to speak English all the time so that they may get used to how we pronounce the words

so we decided on 'language' as the problem here..

specifically - language in written work..

MA teachers were comfortable with each other, as the postings above indicate. An initial idea put forward by MA-2 was respectfully challenged, which is a sign MA teachers felt comfortable about questioning the views of other MA teachers. Teachers expanded on postings made by others and worked as a team to converge towards a discussion outcome. It was also apparent the community knew exactly what the purpose of the conversation was, as evidenced by MA-4’s reminder to her community that they needed to address a problem that might lead to change in teaching practices. The transcript is somewhat disconnected in parts, and lacks a chain of evidence that might reasonably be expected to lead to the conclusion the community reached. There is, therefore, both implicit and
explicit evidence in this discussion transcript and elsewhere that MA teachers used parallel communication paths.

Perhaps the most important result of this investigation, as far as communication tools are concerned, is teachers appear to have selected tools that were not optimal for completing the project activities. SMS and Facebook were used, but neither of these tools provides an accessible record of project communications and neither has a facility for maintaining an MA professional knowledge base. Nor did SMS or Facebook provide the details of conversations teachers might use to investigate their community performances.

By contrast, the Moodle tools allow any form of digital information to be shared amongst teachers; these include video, large images, and multiple page reports. Teachers also have access to full transcripts of all online communications along with details of when communication took place and who the conversation participants were. All community activities could be conducted using Moodle alone, and it would have been productive to do so. However, many participants chose to use alternatives that were easier to connect to than Moodle, but in the end made it difficult to complete analysis of community performance and difficult to conduct meaningful, threaded, online discussions.

7.14. MA Case Study Summary

This MA case study report has revealed the MA group is the top performing community and was able to complete the project activities effectively. MA teachers came to their professional development programme with a formidable list of skills, predispositions, and knowledge they were able to bring to bear on project activities. The values of friendship, trust, and fairness were other helpful characteristics the MA teachers brought with them to their OLC. These values underpinned the excellent work ethic subscribed to by the MA teachers. They already were good friends, and so avoided the need to build the relationships of trust and challenge that were necessary in order for project discussions to be successful. They were already in regular communication with each other online, and therefore, had the means to immediately conduct project discussions.

Given the above conditions, it may be argued that MA teachers already had the resources within their community to conduct project discussions, and therefore, were not as cognitively challenged as participants in other learning communities who had much to
learn about how to communicate in online discussions before they could begin their project activities.

The MA teachers employed a horizontal management style that had the effect of multiplying the quality of management, given all teachers played a part in it. Consensus decision making processes were well developed in the MA group, which made it possible for this community to adopt and adapt procedures and processes as and when needed to achieve project goals.

For example, although the idea of rules did not, initially, sound appealing to the MA teachers, they eventually gravitated towards the need for guidelines to ensure the timely completion of project activities. The MA teachers showed a strong commitment to their community and often put MA goals ahead of individual goals. They also varied the tools they used and adopted linguistic code shifting in efforts to support improvements in project discussion quality and timeliness.

It was noted that sometimes the MA teachers did not manage time particularly well; had they learned some project management skills, they might easily have overcome some of the time management issues they faced.

While there was no single factor that enabled MA teachers to perform better than the teachers of other learning communities, this group managed the challenges of learning on multiple fronts better than most, in part because they had less initial learning to undertake. They could focus on their professional learning without being overloaded with the need to learn new tools, procedures, processes, and a community approach to professional knowledge building — all at the same time.

7.15. Introduction to LU

The LU group was a learning community that was measurably less successful than the MA group in developing new collective professional knowledge for its teachers. This section explores the factors that may have contributed to the LU group’s performances.

This section has eight subsections. The section begins with a discussion of teacher demographics and the environment in which the LU teachers live and work. The second subsection presents the results of quantitative analysis of LU teacher online performances. The third subsection describes the individual and group values of LU teachers. The fourth
subsection describes the predispositions towards teaching and learning LU teachers brought to TestLed. The fifth subsection discusses the processes and procedures LU teachers employed to complete project activities. The sixth subsection discusses how LU teachers communicated with each other, and the seventh subsection describes the likely learning load LU teachers were subject to as they participated in project activities. The eighth section is a summary of this LU case study analysis.

The data analysed for this section is drawn from (1) project transcripts, (2) TPACKBRU responses, (3) community performance reports, (4) project investigation reports, (5) Field notes taken during professional development workshop sessions, (6) workshop attendance records, and (7) artefacts made available when MA teachers made project presentations to the rest of the learning communities in the TestLed programme.

### 7.16. LU Demographics and Context

The community called LU consisted of six teachers: five females and one male (LU-4). The results shown in Table 40 reveal that all LU teachers own laptops except for LU-1. However, LU-1 went on to say in her TPACKBRU responses that she had broadband access to the Internet and a PC at home.

<table>
<thead>
<tr>
<th>LC Teacher / Characteristic</th>
<th>LU-1</th>
<th>LU-2</th>
<th>LU-3</th>
<th>LU-4</th>
<th>LU-5</th>
<th>LU-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years at time of study</td>
<td>51</td>
<td>32</td>
<td>30</td>
<td>30</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Female</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td>Own a laptop</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Use computers for work preparation</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Have a Facebook account</td>
<td>No</td>
<td>???</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>???</td>
</tr>
<tr>
<td>Have Internet at home</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Collaborative learning experiences</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 40. LU teacher characteristics
However, only three teachers (LU-3, LU-4, and LU-5) mentioned using Facebook for social networking in their TPACKBRU questionnaire responses, and therefore, it does appear that LU teachers may not have had a common social networking medium with which they were familiar. Results suggest Facebook communication was not an option for LU teachers. No LU teachers mentioned making use of Facebook to participate in project activities in any of their 106 project discussions. This is a very different experience to that of the MA teachers who mentioned the use of Facebook to promote dialogue during project activities on 89 occasions in 132 project discussions.

Therefore, if LU teachers, for one reason or another, were unable to use Moodle facilities, the best they could do was to e-mail each other, or communicate using SMS, and as previously mentioned, these alternate tools may not be optimal for conducting project discussions. Teachers do not always respond in a timely manner to e-mail and it is all but impossible to conduct group discussions using SMS.

7.17. LU Moodle Server Log Analysis

This section shows the results of quantitative analysis of Moodle server logs and project reports. SPSS and Excel were used to analyse web server logs to produce descriptive statistics that reveal LU teacher participation characteristics. Atlas Ti was used for quantitative analysis of LU discussion transcripts, LU investigation reports, and LU performance reports using Atlas Ti version 6.

The results presented in Table 41 reveal the extent to which individual LU teachers participated in Moodle activities. It can be seen that Moodle activity frequency distributions were far from even, and that one or two teachers were much more active than others. Therefore, given this was the case, it follows that the content of discussion transcripts, wikis, and reports were largely influenced by the views of only one or two teachers instead of all six teachers of LU.

<table>
<thead>
<tr>
<th>Moodle activity</th>
<th>LU-1</th>
<th>LU-2</th>
<th>LU-3</th>
<th>LU-4</th>
<th>LU-5</th>
<th>LU-6</th>
<th>Med</th>
<th>LQ</th>
<th>UQ</th>
<th>IQR</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>22</td>
<td>4</td>
<td>19</td>
<td>8</td>
<td>35</td>
<td>24</td>
<td>20.5</td>
<td>7</td>
<td>26.75</td>
<td>19.75</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td>Chat view</td>
<td>10</td>
<td>5</td>
<td>9</td>
<td>14</td>
<td>9</td>
<td>13</td>
<td>9.5</td>
<td>8</td>
<td>13.25</td>
<td>5.25</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>106</td>
<td>4</td>
<td>3</td>
<td>1.75</td>
<td>31.75</td>
<td>30</td>
<td>106</td>
<td>1</td>
</tr>
</tbody>
</table>
The “Forum add post” line of Table 41 (above) shows that LU-1 (119 posts) and LU-5 (87 posts) contributed 73 percent of all contributions to project discussions. The remaining four teachers contributed 78 (27%) posts to project discussions. The following bar chart (Figure 14) illustrates that LU-1 and LU-5 contributed to discussions many more times than other members of LU. At one extreme, LU-1 made more postings than anyone in any OLC, and at the other extreme LU-4 made only the one posting, the lowest frequency of any member of any OLC. Therefore, it is fair to say, two LU teachers (LU-1 and LU-5) were very active, and the remaining four teachers participated in Moodle discussions comparatively infrequently.

The median discussion post frequency for LU teachers is 31. This is a much lower median value than that generated by other learning communities. For example, the median post frequency of the MA group is 112 discussion posts per teacher. The majority of online discussions contributions were made by LU-1 and LU-5, meaning that the experience and
knowledge of the other four teachers of the LU group may have been underutilized if
dialogue between LU teachers was limited to Moodle discussion forums.

The following table (Table 42) compares Moodle activity frequency statistics generated
by the LU group with the statistics generated by all learning communities as a whole. The
first column presents the total frequency of all activities: the total number of chat talk
contributions (LU Total) is 112. The next column shows the LU ranking; for chat talk;
this ranking is 9, indicating the LU group had the second lowest activity level of any of
the ten learning communities (for chat talk). The median number of posts to chat sessions
was 20.5 (LU Median), which placed the LU group in eighth position in a ranked list of
all ten learning communities. Therefore, it is reasonable to infer the LU teachers made
less use of the Moodle chat facility than most other learning communities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>LU Total</th>
<th>LU Rank</th>
<th>LU Median</th>
<th>LU Median Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>112</td>
<td>9</td>
<td>20.5</td>
<td>8</td>
</tr>
<tr>
<td>Chat view</td>
<td>60</td>
<td>4</td>
<td>9.5</td>
<td>5</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>122</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Forum add post</td>
<td>284</td>
<td>5</td>
<td>31</td>
<td>8</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>1173</td>
<td>5</td>
<td>120</td>
<td>5</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>129</td>
<td>4</td>
<td>0.5</td>
<td>9</td>
</tr>
<tr>
<td>Wiki view</td>
<td>784</td>
<td>4</td>
<td>42.5</td>
<td>8</td>
</tr>
<tr>
<td>Wiki view all</td>
<td>23</td>
<td>7</td>
<td>2.5</td>
<td>9</td>
</tr>
</tbody>
</table>

The LU Rank values in the above table show that the LU group was slightly more active
than most other learning communities in most categories. In the important Forum add
post category, LU teachers contributed the fifth highest (out of ten learning communities)
number of postings to project discussions of any OLC. In the Wiki Edit category, LU
teachers generated the fourth greatest number of editing changes to wikis. However, these
statistics are deceptive because nearly all LU group activity was the result of the actions
of two teachers (LU-1 and LU-5) and not the whole OLC. The final column (LU Median
Rank) is a better indication of LU performance than the LU group total because the
median frequency ranking position shows that their performances were near the bottom of the ranking list in all categories. Therefore, the LU group was one of the least active of all learning communities in this study. These results support an argument that LU teachers created fewer opportunities for professional learning than most other learning communities because they created fewer opportunities for dialogue than other learning communities.

Results shown in Table 42 reveal the LU group is ranked fourth in the wiki edit category. However, this statistic is misleading since the median number of wiki edits is 0.5, the lowest of all learning communities. LU-5 was responsible for nearly all wiki edits.

There are at least two plausible reasons that might explain why it appears as though LU-5 almost singlehandedly completed the wiki. Firstly, the LU wikis may have been constructed elsewhere, and LU-5, as the designated typist, created a Moodle wiki that represented the views of all LU teachers. The fact that all LU teachers viewed the wiki (at least sometimes) lends support to this argument; the following discussion post supports that perception:

```
LU-5
14 April 2011
07:20 P.M.

LU-1 kept everyone working together, pushing us to do things. Hehehe jgn marah ah see moi... I did most of the typing... Some of the applications was helped by rest of the teachers like helping to convert to the PDF file.
```

A second factor that may account for the way the LU group constructed wikis is that LU teachers simply did not learn how to negotiate new collective meaning. This argument is supported by the results of analysis of project discussions that show LU teachers did not appear to know how to build discussions that might generate new professional knowledge. No LU-teachers had prior experience building wikis, and it may be that most LU teachers, with the exception of LU-5, felt overwhelmed by the possibility of having to learn a new and unfamiliar technology. Additionally, collective editing of a wiki may have become difficult to do when LU teachers realised they had insufficient time remaining to complete this activity. LU teachers needed both time and a suitable technology platform to facilitate wiki development.
good points - learn something new e.g. wikis and moodle. meeting other teachers and sharing ideas bad points - can't access Moodle outside the course, too much work load, unable to allocate time to generally really sit down and think about the issues, questions....some have not access to viable Internet access

Although teachers in the LU group realised the importance of participating in project activities, most LU teachers did not take part in professional learning activities. For whatever reasons, the realisation that participation was important did not translate into actions, and therefore, the quality of professional learning available to LU teachers was impacted.

In response to a personal e-mail communication (June 2012), LU-5 provided an indication of why she thought most LU teachers did not participate as often as teachers in other learning communities.

Personal email correspondence with the researcher

Hello Mr Michael
First I am sorry for the late reply. I was 27 years old last year and began teaching in 20th November of 2006. LU-1 and I actually knew each other from previous professional development programs that were going on at the time and also the year before. The only think I could think of was that most of the teachers had a heavy workload and did not have a very easy access to the Internet. One of them lived in Temburong, and didn’t actually have an Internet connection and I think he didn’t really came to the workshop. Mostly LU-1 and I conversed on the phone. She would call me and tell me that she has answered the question and I would call her and tell her when I have done something. LU-1 is one of the main reasons that I’ve done a lot of work in the program. She pushed me to do my best. Sorry again for the late reply.
From,
LU-5

LU-5 suggested that workplace commitments were taking up teachers’ time when they might otherwise have been participating in project activities. To add support to the concerns LU teachers had about time management, a search of all discussions completed
by LU revealed that time issues were raised 88 times. The following discussion posting is a typical LU teacher view.

**LU-5**  
**25 May 2011**  
**01:17 P.M.**

is it just me, or the bcat is making our lifes more miserable....too much time and too difficult to explain most of the time... chat sessions-hehe, i am not a chat person actually so the only time i do chat is when we are at the course else like LU-3 said ‘there's nobody inside’... online discussion- feedback is sometime slow as we are clog with other duties but we are somehow getting most of the job done!! [teacher name aliased out by researcher]

LU teachers demonstrated remarkable creativity and initiative at times. In one case, LU teachers observed their Year 7 science students often performed poorly in science assessments, but at the same time, thought their student’s results were not reflective of successful learning. They had a hunch poor written test results were the result of poor language skills rather than an absence of knowledge about science. Teachers tested their hunch by asking learning communities of students to create videos (with their mobile phones) to show they knew the science of filtration, a recently taught topic. Students recorded filtration experiments and submitted videos to their teacher for assessment. Teachers were able to observe from the videos that students knew the science they had been taught, and that written test results were not measuring student understanding of science.

Serendipitously, LU teachers discovered (1) student videos provided a wealth of information about student learning that was not evident in test scripts, (2) videos could be shared with LU teachers in other schools, and this added credibility, interest, and support for on-going LU professional learning, and (3) students learn by themselves and from each other very well, and do not need to be guided step-by-step by the teacher on every occasion.

The last observation may have challenged some LU teachers’ beliefs that their responsibility was to supply subject knowledge to students rather than to facilitate students’ learning. Teachers in the LU group learned about the practicality of promoting distributed cognition in classrooms — and with the community at large (Angeli, 2008; Schwartz, 2008).
7.18. LU Teacher Values

LU teachers had similar values to MA teachers. The comment from a discussion LU-3 participated in suggests that LU teachers had many of the values that would help a group of teachers work together very well.

My LU group is always humble. Very shy and quiet. They are helpful to each other, more than willing to contribute new ideas, try new ideas, honest, very hardworking, don't like to give up, always like to keep up with changes

The following diagram (Figure 15) presents a more comprehensive list of LU shared values. These results show LU teachers shared values that would promote online collaborative professional learning.

![Diagram of shared values]

Figure 15. Shared values of LU teachers

However, there is ample evidence in both the transcripts of LU discussions and in web tracking statistics to support an argument that LU teacher presence online was insufficient to support online collaborative professional learning. The cause of the lack of presence of LU teachers in project activities appears to lie elsewhere.
7.19. LU Teacher Predispositions

The teachers in the LU group were all relatively experienced classroom practitioners. In 2011, LU-1 was entering the twilight of a long teaching career, and the other five LU teachers had each spent more than five years in Brunei classrooms. Therefore, due to their years of learning on the job, LU teachers may have developed firm ideas about professional learning as it applies in the Brunei context. They were likely to be familiar with more traditional forms of professional development, and unfamiliar with the professional development built around the concepts of distributed cognition and collective knowledge building. If these teachers preferred traditional professional development, it could mean they preferred to learn independently of each other rather than collaborating to gain professional knowledge.

LU-1 suggested that some LU teachers did not feel confident enough to share their ideas.

LU-1
27 July 2011
06:29 P.M.

Good points-Can improve teaching and learning, contribute more new ideas, last but not least able to come out with the best solution to tackle the problems
Bad points-Not everyone agree which is the best solution, some teachers are too shy to share their best ideas, they still have the feeling of not able to contribute to PLC, they need to attend Psychology Lesson to overcome their shyness I think

LU-1 voiced her concerns about limited participation in discussions on the part of some LU teachers. However, suggesting that teacher colleagues might “need to attend Psychological Lesson” may have discouraged rather than encouraged improved levels of participation. Clearly, the good teachers of the LU group were willing to try online collaborative professional learning, but they did not know enough about how to do it. LU-1’s comment that some of her colleagues needed a “Psychology Lesson” (in the quote above) indicated she herself was unfamiliar with the types of dialogue that would encourage participation and help to support community cohesion.

One LU view was that teachers failed to disagree with others for fear of offending them. If this observation on the part of LU-1 was correct, it supports the argument that LU teachers did not have a way of introducing alternate views into discussions.
“... though some ideas they dislike they sometimes force themselves to agree with other teachers just for the sake of pleasing other teachers.

There are other postings that further support an argument that LU-1 and LU-5, in particular, found the low levels of participation in project discussions from other LU teachers disturbing. Unfortunately, these teachers (LU-1 and LU-5) did not have an effective strategy they could use to encourage participation. Some LU teachers remained silent rather than suggest an alternate (or any other) viewpoint. The following discussion comment does look as though it should have drawn some reaction from LU teachers, but it did not.

I think we should discuss :- I think spending more time doing REVISION using past years paper is more worthwhile than doing RUBRIC, SELF-ASSESSMENT and PEER ASSESSMENT, Do all LU teachers agree with me ? Both used up papers, but I still think REVISION using last years paper will help our students achieve better results.

[LC name replaced with code]

There were at least two consequences when LU teachers failed to challenge the views of their colleagues. Firstly, LU teachers missed opportunities for professional learning that can occur during discussions. Secondly, views expressed by an individual in LU became a part of an increasingly unreliable and inaccurate LU knowledge base.

LU teachers produced 50 project discussion agreement statements and no disagreement posting in the nine months of TestLed. It is apparent that the LU group culture did not support explicit disagreement amongst teachers.

Yes i can agree with all the comments here. Is it because they forgot which formula to apply, they don’t understand the questions or they just don’t pay attention during our explanation. Sometime, it was only like the day before we taught them then the next day, they just don’t know how to do the calculation.

7.20. Processes and Procedures Used by LU Teachers

LU-1 and LU-5 completed most project activities between themselves. LU-5 initiated most discussions, created the wikis, and wrote all project reports. LU-1 was an active
participant in discussions and generated most of the data used by her community during project investigations.

7.21. Project Management Activities Used by LU Teachers

LU teachers felt they had insufficient time to complete all project activities. They were, at the time of TestLed, required to participate in the Brunei Common Assessment Tasks (BCATs) project, a series of activities that loaded Year 7 science teachers with an additional amount of assessment work on top of their regular teaching load during most of 2011. This being said, teachers in all learning communities were under this same pressure to manage BCAT activities, and some of the other learning communities coped with their workload.

LU-4
13 September 2011, 08:45 P.M.

obviously time constraint is always the problem. we comes up with ways to help PLCs meet despite time constraints.

LU teachers did not focus on analysing and improving community performance beyond stating there were time and participation issues that needed addressing.

LU-1
21 August 2011, 06:20 P.M.

No rules were created to enable our LU Group to function more effectively, so that we all share our burden together, whether we are successful or fail towards the end we all sail in the same boat, if we safe we enjoy our success, if we fail, we all sink down together. [LC name replaced with code]

LU results suggest that opportunities for learning were limited because of the way project activities were conducted. Once LU-1 and LU-5 established a process for completing project activities, this was maintained because LU teachers did not question it. The following section reveals some of the reasons why LU teachers completed project activities in the way they did by considering how these teachers made use of project completion guidelines and resources they were provided with.

7.22. LU Adoption and Adaption of Project Completion Guidelines

The LU teachers had ample opportunity to develop and refine their interpretation of project completion guidelines so they could meet their OLC’s professional learning goals.
All LU teachers had access to a copy of the book, *Professional Learning Communities: An implementation guide and toolkit* (Foord & Haar, 2008). A copy of this book was provided to each school that contributed teachers to TestLed. Teachers were also provided with printed information about how to complete project activities. All teachers were invited to attend a series of 11 workshops and sharing sessions where they could further discuss their community concerns as well as their project achievements. In addition, community teachers could contact other teachers and the researcher either in person or online to discuss challenges they were facing. Therefore, it is reasonable to argue that LU teachers had access to resources they could use to learn how to create and sustain their OLC.

LU teachers understood and properly implemented the teaching and learning investigation part of the project completion guidelines. The reports produced by the LU group showed they conducted interesting and innovative experiments in their search for solutions to teaching problems. However, LU teachers did not always answer community performance investigation questions accurately. The following discussion is an example of how LU teachers mistakenly thought they should investigate the relationship *students* had with external activity systems, instead of the relationship between LU *teachers* and external activity systems.

14 April 2011
09:05 P.M.
LU-5

*Hehehe.... Can someone explain to me....*

14 April 2011
09:06 P.M.
LU-1

*Yes, the project (subject) did make good use of external activity systems (Community). The student did seek help from brothers, sisters, fathers, mothers, relatives and friends and even traveled to computer shops to seek help how to make Good video.*

18 April 2011
07:03 P.M.
LU-5

*ok. I agree with you.*

9 April 2011
10:32 P.M.
LU-3

*i don't really get what this topic means and my Internet speed is making me more stressful... so i just agree with you all hehehe...*

23 May 2011
09:28 P.M.
LU-6

*doing the filtration, my students did get some help from family teachers in doing and presenting the videos...so yes, community did play a major role in helping the subject to accomplish a given task...*
LU teachers failed to address the tension between community pressures and subjects (the LU teachers). Teacher workloads were frequently mentioned as being the reason they had little time for community activities. If LU teachers had found ways to reduce individual workloads, more time could have been available for professional development. In any event, a discussion did not take place; therefore, LU teachers never investigated how they might increase the time they had available for project activities.

A further concern highlighted in the above transcript is that discussions extended over weeks when a focused discussion may easily have been completed in minutes. The first posting to this discussion was in mid-April, and the last comment was made towards the end of May. This was far too long a time to complete a discussion as it left little time for other project activities. Therefore, LU teachers lost opportunities to improve the way their community achieved professional learning outcomes.

7.23. LU Management Style

The LU group had a vertical (hierarchical) management structure. One teacher was deemed the leader of LU, and another, the secretary. The following transcript provides an insight into how LU teachers viewed the management of their OLC.

13 April 2011, 04:08 P.M. 
LU-5
... [Moodle posting created by LU-5 to initiate this discussion]

14 April 2011, 09:04 P.M. 
LU-5
So who is the boss??? ada kah?

14 April 2011, 09:09 P.M. 
LU-1
LU-5 is our small Boss and Sir Michael Moroney is our BIG BOSS

8 April 2011, 07:03 P.M. 
LU-5
hahahaha..... mana ada...

19 April 2011, 10:30 P.M. 
LU-3
if u ask for my opinion. LU-1 is our boss since she provide us with all the students experiment results and reports. LU-5 is our secretary since she's doing all the typing. myself is just an underling hehehe... so basically we volunteered to do things [names aliased out; LU-1 identified as the “boss” and LU-5 as the “secretary”]

23 May 2011, 09:30 P.M. 
LU-6
yup yup!! 120% agree with LU-3!hehe [LU teacher name aliased out but referred to LU-3]
The LU group did not have a single teacher who was familiar with all aspects of developing and sustaining a community and completing project activities, and therefore, no suitable candidates for LU leadership. LU group management may have been more effective if decisions were informed by the collective wisdom of all LU teachers. In addition, if teachers had been involved in decision-making, they may have been more likely to actively support such decisions.

The LU leader unwittingly made decisions that took away learning opportunities for four teachers. Four LU teachers did not learn how to participate in the sort of decision-making activities that would have built LU cohesion and focus. Instead, teachers preferred to be underlings as mentioned in the quotation displayed in the management style section above. Teachers did not participate in activities such as wiki building, and therefore, did not experience negotiating meaning or development of their LU knowledge base.

7.24. LU Teacher Talk

This section discusses how teachers communicated with each other during project discussions. It presents the range of digital tools teachers used in project discussions as well as the languages they used with different communication channels and for different purposes.

7.25. LU Use of Linguistic Code Switching

LU-5 added the occasional Malay phrase to postings, but in general, code switching was not a feature of the LU group discussions. Project discussions were conducted in conversational English language that seemed to be accessible to these non-native English speakers. The following transcript illustrates the type of language used by LU teachers when they posted to project discussions.

27 July 2011, 02:51 P.M. LU-5 - [initial post made to start this discussion thread]  
27 July 2011, 06:19 P.M. LU-1 Whether they are doing the Correct or incorrect models  
18 August 2011, 03:06 P.M. LU-1 WAU ! their models making ALL deserve grade “A’, I saw students carried baskets full of NEW re-used materials to improve on their model making. They were all SMART students.
yes i agree, my low achievers were very more enthusiastic about the model making and they went and bought the coloured ice-cream sticks and beads, the models were very good.

Since LU teachers did not require the use of Standard English in project discussions, language did not present a barrier that might have prevented these teachers from having the confidence to participate in project activities.

7.26. Production of project Reports by LU Teachers

LU-5 assumed responsibility for independently completing all the project capstone reports required of her OLC. This was to be expected, since LU-5 also completed wikis, and reports were summaries of the LU wiki pages she had created. However, this uneven division of labour had consequences for LU professional learning, some of which are described in the paragraphs that follow.

Since LU-5 authored all reports, the views expressed in reports may not have reflected the views of all LU teachers. This is likely to be the case given that most teachers did not contribute regularly to Moodle discussions or LU wikis, and therefore, LU-5 did not have transcript data to draw on when defining common LU positions in wikis and reports.

The wiki building and report writing activities were important opportunities for professional learning, and five of six LU teachers did not participate in development of these. Several reasons may contribute to an explanation of why LU participation levels in discussions were low, and it is likely a combination of these. Firstly, teachers indicated they were busy and did not have time to contribute to project discussions. Secondly, LU teachers did not have the means to communicate easily given that some had to overcome Internet access barriers to log in to their Moodle accounts. Thirdly, teachers were not able to plan accurately for participation in project activities, and therefore, usually tried to complete many project activities when there was insufficient time to do so. Fourthly, LU teachers failed to coalesce into a community with a common purpose and focus aligned with the goal of developing professional knowledge for LU teachers. Fifthly, teachers did not realise the effect of non-participation in project activities on the professional learning outcomes of all LU teachers. Sixthly, project activities were viewed as ends in themselves rather than as opportunities for professional learning. Because of this, LU teachers were unlikely to experience short-term gains in professional knowledge that might have
encouraged sustained levels of participation in LU activities; they simply did not have enough reasons to want to connect.

7.27. The Use of Multiple Communication Channels by LU Teachers

The LU teachers were not friends before their professional development programme began, and they lacked a common social networking platform with which they were all familiar. LU teachers, therefore, needed a communication channel for online dialogues, and they adopted Moodle for this purpose. Alternate communication channels mentioned by LU-1 and LU-5, in particular, included mobile phone conversations and the use of SMS. Moodle was not an entirely practical platform for conducting project discussions, as teachers often failed to respond to discussion threads in a timely manner.

The LU teachers made several comments to the effect that they valued the use of synchronous communication rather than the asynchronous discussion and wiki building activities of project activities. This, in itself, was problematic as most LU activities were best conducted using an asynchronous mode of communication. However, when teachers did schedule online chat room sessions, it was often the case that only one person participated; as a result, interest in synchronous conversations quickly died away.

The LU teachers did not all have easy access to the Internet and some never overcame the challenges that prevented them from regularly participating in Moodle activities. With limited access to the Internet, there was limited opportunity to produce the levels of communication required to build a cohesive and focused LU community. LU-5 and LU-2 completed most activities, in part at least because other LU teachers did not have access to the Internet. However, the efforts of LU-5 and LU-1 alone were always going to be insufficient to sustain their OLC:

“Individuals working alone, no matter how competent or charismatic they are, will never have everything that is needed to overcome the powerful forces of tradition and inertia.” (Richard Dufour et al., 2008, p. 99)

For the LU community to be successful, it needed a critical mass of teachers from within its ranks who could champion and sustain their project processes, change those processes that did not work, and negotiate a functional management style that was inclusive of all views and teachers.
7.28. Acceptance of Collective Cognitive Responsibility by LU Teachers

Results suggest LU teachers did not work together to advance collective professional knowledge. The reason may well be due to the learning load issues discussed in the above section and the lack of an LU community approach to deal with this. The LU discussion transcript analysis highlighted that relationships of respect and challenge and significant amounts of teacher dialogue are characteristics of successful learning communities that were missing from the LU group’s project activities. The willingness of LU-1 and LU-5 to do more than their fair share seems to have been counterproductive as it deprived other LU teachers of the responsibility and the opportunity to feel a part of the LU community.

In most instances, three or four teachers of the LU group were satisfied not to contribute to project discussions, which left the lion’s share of discussion postings to LU-1 and LU-5. Therefore, without their input, conjecture suggests the sense of collective cognitive responsibility was clearly missing.

7.29. LU Case Study Summary

This researcher supports an argument that community performance levels are strongly influenced, amongst other things, by a combination of the following:

1. cognitive overloading;
2. project management skills;
3. management style;
4. explicit goals and a well-defined focus;
5. individual and group values;
6. data awareness;
7. digital literacy skills;
8. the social learning skills, including linguistic code switching, necessary to develop online conversations in ways that generate new collective professional knowledge;
9. communication technologies;
10. social networking soft skills required to promote communityness and community cohesion;
11. relationships of respect and challenge; and
(12) the number of active community teachers.

There is ample evidence in this study that if a community is unable to control for any one of the above factors, it will likely be unable to attain collective professional learning goals. This is because any of the above 12 factors, when not controlled for, prevents the development of a collective professional knowledge base that advances individual knowledge. Under such circumstances, teachers would have no reason to support their OLC.

It is important to add there was no evidence found in this study that any of the above factors may represent an insurmountable challenge for community development and sustainment.

What is apparent, from these results, is that individual community development requirements need to be carefully considered at an early stage, and that appropriate external expert support is probably necessary to enable community teachers to overcome the developmental challenges they face. It is clear that every community will start with a unique set of collective and individual characteristics that need to be taken into account before individual community development strategies are developed and implemented. The goal of such development would be to enable a community to reach a point where professional knowledge could be developed effectively for the benefit of all community teachers.

Once a community reaches a stage of development akin to the stewardship developmental phase of CoP theory (Wenger et al., 2002), professional knowledge development will be at a desirable productive level. However, in contrast to stewardship in CoP theory, community stewardship is unlikely to be a fixed state, and teachers will continually be required to balance many tensions — including those that exist between tools, community, rules, and division of labour, object, and outcomes — to sustain an unstable and fragile community entity. Therefore, it is not only appropriate that teachers learn about teaching, but that they learn how to assess the health and wellbeing of their OLC, and that they develop strategies they can use to meet the community development and sustainment challenges they will surely need to overcome.
7.30. Learning Load

In the context of this study, cognitive overloading may have occurred when community teachers were overwhelmed by the amount of learning expected of them in a short amount of time. It is possible some teachers lacked a number of prerequisite competencies required of OLC participants, and that acquiring the necessary multiple competencies in a short amount of time was very challenging for them.

Cognitive underloading may have resulted as overwhelmed teachers disengaged from OLC activities because they never managed to acquire the prerequisite skills and knowledge they needed to participate. Results of application of the PLLI indicate that LU teachers had a higher cognitive load factor at the beginning of their programme than did MA teachers. Factors that influenced learning load are displayed in Figure 16.

![Figure 16. Factors influencing learning load](image)

The diagram shows a number of sources of intrinsic and extraneous cognitive load that limit the capacity, or even prevent teachers from successfully participating in collaborative professional learning. Some teachers had more learning load challenges than others, and inexperienced teachers required different learning opportunities than those who already had most of the knowledge and skills they needed to be able to participate in a community project.
7.31. Prerequisite Competencies

In this study, a set of prerequisite competencies was found to include (1) inquiry mindedness; (2) collaborative professional learning skills and knowledge; (3) data capture, analysis, and presentation skills; (4) ICT skills and knowledge; (5) online social networking skills; (6) multiliteracies; and (7) self-management skills.

Some participants in this study were unfamiliar with all seven learning areas and had a lot of learning to do in a short amount of time before beginning community project activities. By contrast, other participants had most of the prerequisite competencies so had very little to learn before embarking on project activities.

7.32. Group Developmental Requirements

In addition to developing skills and knowledge, teachers needed to develop relationships of trust, respect, and challenge with other teachers in their community (Duncombe & Armour, 2004; Graham, 2007; Timperley & Earl, 2009). However, developing such relationships in an online setting is much more difficult than doing so in a face-to-face setting (Lund & Rasmussan, 2008). Some learning communities of teachers had existing well-established relationships of trust, respect, and challenge, while other learning communities needed to start from scratch in February of 2011. Some teachers failed to manage to do this, and as a result, limited their own learning and also the collective learning of their community.

7.33. Pre-training Learning Load Indicator

The Online Learning Community Development Indicator (OLCDI) was first introduced in section 3.5 (Table 7) as an instrument the researcher developed during this study to determine the location of a learning community on a developmental trajectory at a given point in time. The rubric below (Table 46) is a subset of the OLCDI, called the Pre-training Learning Load Indicator (PLLI). This instrument provides an indication of the learning teachers would benefit from completing before attempting to to maintain and develop an online learning community. The PLLI prioritises the importance of seven skills and knowledge items, and two teacher prerequisite predispositions: an inquiring habit of mind and relationships of trust and challenge. These predispositions are important if teachers are to conduct open and frank discussions that might lead to
evidence of professional learning (Aikenhead, 2006; Dede, Jas Ketelhut, Whitehouse, Brett, & McCloskey, 2009; New Zealand Ministry of Education, 2006). The other seven prerequisites represent knowledge and skills teachers must learn before participating in project activities. These include community building skills, familiarity with a protocol for conducting an investigation of a teaching and learning problem, meta-cognition skills, knowledge of the features and constraints of communication technologies, familiarity with research processes and procedures, digital literacies, and capacity to build collective knowledge through collaborative professional learning.

Table 43. Pre-training Learning Load Indicator (PLLI)

<table>
<thead>
<tr>
<th>Skills, Knowledge, &amp; Predispositions</th>
<th>High performing community</th>
<th>Underperforming community</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Community building skills and knowledge</td>
<td>Teachers are committed to participating in activities that sustain the community</td>
<td>Little or no evidence of community building activities</td>
</tr>
<tr>
<td>2 Teaching and learning investigation protocol</td>
<td>Teachers easily followed the teaching and learning protocol</td>
<td>Teachers failed to complete teaching and learning investigation steps successfully</td>
</tr>
<tr>
<td>3 Community knowledge production capacity review</td>
<td>Teachers successfully evaluated the capacity of their community to learn</td>
<td>Teachers failed to complete an evaluation of the learning performance of their community</td>
</tr>
<tr>
<td>4 Communication technologies</td>
<td>Teachers had access to and knowledge of how to use a range of tools that they used to complete projects</td>
<td>Teachers used tools ineffectively.</td>
</tr>
<tr>
<td>5 Research skills</td>
<td>Teachers demonstrated knowledge of research skills</td>
<td>Teachers had insufficient research skills to complete a project</td>
</tr>
<tr>
<td>6 Multiliteracies</td>
<td>Teachers generated evidence of used multiple communication modes effectively</td>
<td>Teachers failed to generate evidence of high levels of digital literacy</td>
</tr>
<tr>
<td>7 Inquiry habit of mind</td>
<td>OLC teachers were passionate about investigating teaching and learning problems</td>
<td>No evidence of effort to develop new knowledge to solve a teaching problem</td>
</tr>
</tbody>
</table>
8 Collaborative learning skills
Teachers participate effectively in online discussions
Little or no deep discussion leading to collective knowledge building

9 Relationships of respect and challenge
OLC teachers are comfortable challenging ideas and respecting teachers views
OLC teachers choose to stay quiet rather than challenge ideas; challenge to ideas may be viewed as a personal attack

The community PLCI score was calculated by aggregating individual teacher scores and then averaging for the community. No weightings were applied to items in the PLLI, and teachers were awarded either 1 or 0 for each item in the PLLI rubric. PLLI scores for each OLC were drawn from TPACKBRU questionnaire responses, from analysis of online discussions, and analysis of project reports.

The PLCI scores reported in Table 44 show that most MA teachers had all the prerequisites required to begin a project at the beginning of their professional development programme. On the other hand, a review of LU web tracking data, LU reports, and LU online discussion transcripts produced little evidence that LU teachers had more than a few of the PLLI skills, knowledge, and predispositions required before beginning a project.

Table 44. PLLI comparison between MA and LU

<table>
<thead>
<tr>
<th>Skills, Knowledge, &amp; Predispositions</th>
<th>MA PLLI scores</th>
<th>LU PLLI scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Community building</td>
<td>4/4</td>
<td>2/6</td>
</tr>
<tr>
<td>2 PLC protocol - school investigation</td>
<td>4/4</td>
<td>1/6</td>
</tr>
<tr>
<td>3 PLC protocol - community learning performance review</td>
<td>2/4</td>
<td>3/6</td>
</tr>
<tr>
<td>4 Communication technologies</td>
<td>3/4</td>
<td>4/6</td>
</tr>
<tr>
<td>5 Research skills</td>
<td>4/4</td>
<td>2/6</td>
</tr>
<tr>
<td>6 Digital literacy</td>
<td>4/4</td>
<td>4/6</td>
</tr>
<tr>
<td>7 Inquiry habit of mind</td>
<td>4/4</td>
<td>2/6</td>
</tr>
<tr>
<td>8 Collaborative learning skills</td>
<td>4/4</td>
<td>2/6</td>
</tr>
<tr>
<td>9 Relationships of respect and challenge</td>
<td>4/4</td>
<td>2/6</td>
</tr>
<tr>
<td>Averages</td>
<td>29/36 = 81%</td>
<td>22/45 = 49%</td>
</tr>
</tbody>
</table>

199
MA teachers were friends before they began the TestLed programme; therefore, it was easy for them to establish the relationships of respect and challenge that are important to a community (Timperley & Earl, 2009). These participants were also familiar with Facebook and SMS, and furthermore, had regularly communicated with each other with these tools for a number of years before their professional development programme began. Therefore, MA teachers had little to do in the way of developing the prerequisite skills, knowledge, and predispositions before participating in project activities.

Specifically, they had no need to develop a community as it was already developed, and they did not need to develop communication skills because they already had them. They did not need to develop many research skills as they demonstrated they could produce and interpret a range of descriptive statistics and appropriate graphical representations.

One of the greatest challenges MA teachers faced was their inability to effectively and efficiently manage a complex project over an extended period of time. These teachers consistently reported they compressed activities into a short amount of time near to a project deadline. It follows that these teachers might have been able to benefit more from their professional development if they had access to appropriate project management tools and the knowledge of how to use them.

MA teachers, however, gave no indication they mastered a process for selecting appropriate tools for conducting project activities. As with all other learning communities, MA teachers failed to identify alternatives to Moodle for recording communications that contributed to project activities, and they also struggled to select a tool to support maintenance of an accessible online knowledge base. Instead, they used the communication tools they were most familiar with, including Facebook and SMS without fully realising they would not have access to the conversation transcripts that would be needed for project analysis.

MA teachers only needed to spend some time working out which tools would be most appropriate for different types of project activity. It would be useful to theorize the task / tool relationship when learning communities are required to build knowledge online (Lund & Rasmussan, 2008).

LU teachers were not friends with each other in the beginning, although LU-1 and LU-5 were passing acquaintances having attended the same workshops at different times in
recent years. Therefore, according to CoP theory, LU teachers needed to coalesce into a group with a common purpose and focus if they were to be able to complete joint projects. They needed to develop trustful relationships that would enable them to communicate openly, and to agree on common goals so all members of the community would feel they had a good reason to want to participate in community activities. Analysis of the LU group’s discussion transcripts shows little evidence of communityness and no community-building activities having taken place.

It is clearly necessary that all members of a community are able to connect to each other with the same digital technologies. Indeed, many teachers in Brunei like to connect with each other through their Facebook accounts. However, analysis of TPACKBRU responses indicated that LU teachers did not all have Facebook accounts. Furthermore, there was no alternative social networking technology all LU teachers were familiar with that they all could use. Therefore, these participants relied almost exclusively on the use of Moodle to conduct project activities.

LU-1 18 April 2011 06:00 P.M.
Yes, we actually struggle a lot, due to too many unfamiliar skills we need to master in such a short period of time. If only we have more time I believe we can benefit more.

LU-5 18 April 2011 06:28 P.M.
yes i agree with you.. its all new to use and sometimes the mind came up totally blank..

LU-3 19 April 2011 10:09 P.M.
also i kesian for you guys who has to travel long distances to get to the course, i’m sure by the time you arrive, the mind is not working to full capacity...

LU-6 23 May 2011 09:12 P.M.
hmm we have some outcome but it might not be similar in everyone cases..we all did arrive at the 1st day not knowing what the courses is all about and at the end of the day we had each our own opinions and personal outcomes....it would have been nice if we spend a lil time getting us accustom with moodle and mahara...hehe

Teachers were required, as a part of their professional development programme, to present their own beliefs about a teaching and learning problem to other members of their community; they were also expected to question the views of others when there was dissonance to be resolved between their own beliefs and those of others. Additionally,
they needed use data to support any views they presented. Analysis of LU transcripts failed to find evidence that LU teachers did these things consistently. Although one or two teachers consistently presented their views, and although there was some use of evidence to support such views, there was very little evidence LU teachers would ever challenge the views of their colleagues.

Sometimes, LU teachers found they failed to schedule sufficient time to complete important project activities. This may have been because these teachers were overly optimistic when predicting how long activities might take, and perhaps the greatest contributor to the learning load LU teachers experienced was that LU decisions were not jointly made by all members of LU. If the collective knowledge, experience, and ability of six experienced and capable LU teachers had been considered when decisions were made, it seems likely these teachers might have overcome the challenges, as the members of other learning communities were able to do.

7.34. Comparison of Demographics

MA teachers were similar in professional experience, age, and qualifications. In addition, these four young female teachers already knew each other and were friends of long standing before beginning their professional development programme. They knew how to talk to each other online, and had been communicating in the same Facebook group for years.

On the other hand, the LU teachers had little in common other than the subject they taught. The oldest teacher was near retirement and all others had at least five years of teaching experience. The six teachers of the LU group included one male and five females.

7.35. Comparison of Moodle Participation Levels

The results of analysis of all 10 learning communities revealed that all successful learning communities had at least four active teachers to engage in project dialogue. In-depth analysis of MA and LU Moodle server log data revealed that all four MA teachers (100%) participated in all project activities throughout the duration of the TestLed programme.
Two out of six LU teachers (33%) participated regularly in project activities. Furthermore, although LU-1 and LU-5 both contributed to all project discussions, they were also responsible for dividing a number of activities between themselves.

7.36. Comparison of Individual and Community Values

The values presented in this section are selected from a comprehensive list developed by (Foord & Haar, 2008). This list of teacher values was chosen because it is often used to indicate how compatible or different teachers of a community are, and therefore, the extent to which a community might have difficulty coalescing into a community with a single agenda as its focus.

The MA teachers had a strong friendship, a strong work ethic, and they placed MA goals ahead of their personal goals. They were disciplined teachers who completed tasks professionally to the best of their ability. They appraised their own individual performances and that of their community honestly. They were goal oriented and mentioned wanting to use project activities to improve their professional knowledge. However, leadership was a value the MA teachers were definitely not interested in. They wanted a say in decisions and did not want one of their teachers to be selected as a leader. Responsibility and respect were also values the MA teachers aspired to. They respected each other as teachers and shared collective responsibility for attaining professional learning outcomes during project activities. MA teachers shared many common values, which had been tried and tested during a friendship that extended for many years. One of the most important values shared by these teachers was learning; they explicitly stated they wanted to gain knowledge that might help them to become better teachers.

In contrast, the LU community of teachers valued leadership, as demonstrated by their explicit acknowledgement of LU-1 as LU leader. However, those teachers who spoke about leadership wanted to be told what to do rather than assume the role of a leader, and their leader did not tell them what to do, but instead, completed much of their work for them, as did the LU secretary.

The LU teachers wanted to finish whatever project tasks they had been set as efficiently as possible. In that sense, these participants valued achievement of project goals such as report writing. However, achievement was not a common value for all of them; most were silent on the matter; and others did not participate in project activities at levels that
supported community goals. While LU-1 and LU-5 displayed an admirable work ethic, the other four LU teachers did not.

LU teachers did not actively seek to establish close relationships or friendships, stating that their innate professionalism as teachers was enough for them to complete project activities. This was the usual practice in the workplace where activities such as test writing were divided amongst teachers in a school department. However, in the context of this professional development, a more trusting relationship was required to accomplish the main task of collective knowledge building.

7.37. Comparison of Predispositions

The MA teachers did not reveal any significant predispositions that might have made it difficult for them to adopt the concepts of distributed cognition, collective learning, and shared cognitive responsibility. They were young teachers who were open to new ideas. Again, this contrasted with the LU teachers who had been teaching longer than the MA teachers. They had developed much more firmly held predispositions towards teaching and learning than had the younger MA teachers.

7.38. Comparison of Procedures and Practices

All MA teachers participated in all activities. All teachers posted at least once to every project discussion. Teachers in the MA group created two rules that encouraged participation. The first was that every teacher must participate in every activity. Secondly, they made a rule that whoever participated last was required to write the project investigation report and community performance report at the end of each PLC. MA teachers monitored their project progress in real time. This would have required observing individual teacher performances in real time in order to make judgements about who was last to complete a project activity.

MA teachers used Facebook to conduct discussions and then went back to Moodle discussions to write down what they had concluded. They stated they did this to ensure there was a permanent and accessible record (digital footprint) of their discussion. They used a range of different communication methods to try to make it easier to conduct project discussions.
The MA teachers carefully completed their community performance investigation, and addressed challenges with new strategies. These strategies did not always work, but they did suggest that MA teachers were trying to continuously improve over time.

The LU teachers did not all participate in all activities. Indeed, project tasks were often divided between LU-1 and LU-5. LU did not invoke rules although they realised they all needed to work together to meet or exceed their professional learning expectations and must have known they had silent partners in their ranks. LU-1 and LU-5 monitored each other’s progress and cooperated to complete project activities. They generally did not delegate activities to others in the LU group, preferring instead to rapidly complete many online discussions. The LU teachers did not fully complete community performance investigations, and therefore, did not actively seek to continuously improve their community performances. Indeed, the practices and procedures used by the LU community were fixed during their first project, and they did not change after that.

7.39. Comparison of Project Management Characteristics

Both MA and LU learning communities realised the importance of project management, but neither of them demonstrated mastery or knowledge that might have been used to ensure the timely completion of project activities. This had a significant impact on the quality of their respective professional development experiences. If time had been managed better, opportunities for professional learning would have been advanced. Instead, too little time was left at the latter stages of a project to be able to complete it.

7.40. Comparison of Adoption and Adaption of Project Completion Guidelines

Both learning communities conducted excellent teaching and learning investigations. However, as mentioned in the section above, time was not managed well, and projects were coming to a close before teachers had begun to consider their OLC. All professional development programmes must be evaluated to measure their effectiveness (Guskey, 2000). In the case of learning communities, it is up to the teachers themselves to look at their own collective and individual professional learning. The MA teachers did evaluate their community thoroughly although they invariably ran over time and occasionally produced reports well after a specified completion date. The LU community did produce reports, but these were not nearly as comprehensive as those produced by the MA group.
— and they clearly lacked the input and wisdom of all the teachers in the group. As a result, the LU reports were not acted upon to improve the LU procedures and practices. On the other hand, the MA group’s report production led to ever more satisfying community performances.

7.41. Comparison of Management Styles

The MA teachers decided to use a horizontal management style; together they made decisions about procedures and processes for conducting project activities, and did not appear to produce any decisions that might have harmed their chances of meeting or exceeding their professional learning goals.

LU-1 was the leader of her OLC. This group of teachers decided to adopt a vertical management structure that appears to mirror the one found in Brunei secondary school departments. In those schools, a head of department would allocate tasks to underling teachers. The LU teachers appeared to be comfortable with this management structure as was indicated by their stating they wanted to be told what to do; however, in this particular case, their leader did not tell them what to do, but instead, completed much of their work for them, as did the elected LU secretary. There were many times (17%) when only one LU teacher participated in a project activity designed for online collaborative professional learning.

The decision to place leadership in the hands of one person was one of a number of management decisions that harmed the chances of LU teachers meeting their professional learning goals. As a result of this decision, most LU teachers simply did not get involved in the very activities that might have generated opportunities for professional learning.

The leadership of a community is too important a position to leave in the hands of one person, as the results of her decisions have a significant bearing on the professional learning of all community teachers. The results of this study show that for this group, a single leader did not satisfactorily direct project activities — and indeed misdirected them. Had the other five teachers of the LU group assisted in the decision making processes, this almost certainly would never have happened.
7.42. Comparison of the Use of Tools

MA teachers made use of a range of communication tools including Moodle, Facebook, and SMS. These teachers found solutions to their communication challenges that enabled them to complete their project activities. However, MA teachers picked communication tools they were comfortable with without fully investigating the impact their use would have on their professional learning aspirations. Importantly, the MA teachers failed to realise the importance of being able to look back on evidence of how they had performed during their PLC. In this sense, the tools they chose to use were not fit for the purpose as they did not have access to web log statistics or transcripts that are typically required for meaningful evaluation of online performances.

The LU teachers made use of Moodle. These teachers had access to evidence of performance, but they did not use it in investigations to evaluate their own performances. The LU teachers identified communication problems, but did not adopt the use of alternative tools that might have elicited more timely responses from LU teachers. Given the way the LU teachers divided labour between LU-1 and LU-5, there was no need for alternative tools. These two teachers did meet online whenever the need arose. Therefore, given the management structure, and the procedures and processes they chose to use, Moodle was a tool that met all their requirements, and they really had no need to change. Had more teachers participated, the use of Moodle may well have needed to be supplemented by other communication channels as the MA teachers found.

7.43. Collective Cognitive Responsibility

The MA teachers were deeply committed to collective cognitive responsibility as evidenced by the high quality and quantity of project discussion posts. This group listened carefully to what others had to say and made their own contributions to build the collective professional knowledge.

The LU teachers did not appear to support collective cognitive responsibility; instead, they left the development of a professional knowledge base to only one or two teachers. Most LU teachers, more often than not, did not participate in Moodle discussions.

As the LU teachers were professional colleagues but not friends, they may have been guarded in their responses to project discussions, or said little at all rather than challenge the views of others and risk the associated confrontation that might ensue. It might have
been helpful had the LU teachers been able to build trustful relationships between themselves; this, in turn, may have encouraged project participation and open teacher dialogue. Instead, the LU teachers divided the work between themselves, and individual teachers conducted project activities more or less in isolation. The results of their approach suggest the synergy that comes from collective learning never materialised in the discussions completed by the LU group. At the risk of being repetitious, very early management decisions made by the LU leadership predetermined the professional learning outcomes the LU teachers realised. What remains puzzling is why most LU teachers allowed this to happen, given the effect it had on individual professional learning.

7.44. Summary

The MA group was a high performing OLC and the LU group was a less successful OLC. While the reasons for the differences in performance are complex, there are several factors that contribute in an interrelated way to an explanation of the learning communities’ performance levels.

Friendship and the capacity to connect online were characteristics present in the MA community from the beginning, whilst these group characteristics had to be developed by the LU community. From the outset, the LU teachers were required to participate in activities to acquire a baseline set of skills and knowledge, while the MA teachers only had to learn the project protocols for completing online learning activities, and how to manage their time effectively. Both learning communities knew little about project management, which influenced the amount and quality of collaborative professional learning achieved by both learning communities. A vertical management style did fail to produce a desired result in this research; whereas, the more inclusive horizontal management structure worked more successfully. Because community decisions are often complex, it makes sense to use the distributed cognition of all teachers rather than that of one or two management people. The consequence of bad decision-making was to limit the effectiveness of professional learning for the LU teachers, while the MA teachers successfully managed their learning environment without misstep.

No single satisfactory tool for conducting online project activities was found: while Moodle has some suitable communication features (chat, discussions, wikis, web
tracking, and transcript recording) required in a single community package, as this study showed, it was not easily accessible by the teachers and not sufficiently user-friendly for them to adopt it ahead of other tools with which they were already familiar.

The results of this study, therefore, suggest that a suitable online, collaborative, professional learning tool set should have, as a minimum, the following facilities:

- Capture of community activity, and information that can be used to evaluate and improve community performance made accessible to teachers.

- Decision support system to help teachers choose strategies to address community development challenges.

- A project management facility so details of previous projects can be used to inform the design of future project activities, and so projects can be monitored as they progress.

- Multiple communication channels and tools appropriate for different types of community activity.

- Tools that are easy to use, physically accessible, with clear indication of how these tools might be used to support community activities.

- The tools teachers will use will depend, to a large extent, on the level of access to the Internet. Therefore, different learning communities will use different sets of tools.

- A tool set will include an assortment of tools rather than a single one. An exhaustive search for a suitable single integrated tool for learning communities to use revealed that no such tool was available, but there were ways to combine a range of different tools to meet community requirements.

This chapter has highlighted the major factors that helped a successful community to perform well — and the factors that contributed to another community performing less well. The next chapter goes on to discuss the theories that may explain some of these findings, those theories that appear to be contradicted by these results, and some of the above results that were not found in extensive searches of current literature.
Chapter 8. Discussion

8.1. Introduction

This chapter discusses the results presented in Chapters 6, and 7. The discussion is organised using the Cultural-Historical Theory of Activity Framework as an analytical lens, as it has been used throughout this thesis.

This chapter begins with a discussion in section 8.2 about the learning load challenges teachers faced while becoming participants in their learning communities. In section 8.3, an online collaborative professional learning model (Figure 20) explains collaboration as being informed by knowledge at the intersection of technology knowledge, operations knowledge, and collaborative professional learning knowledge. Section 8.4 describes how teachers selected online communication tools and the impact this had on their learning communities’ capacity to achieve professional learning outcomes. Section 8.5 presents some of the motivational challenges and enablers encountered by teachers during projects. The collaborative and cooperative practices of teachers are discussed in section 8.6, and then section 8.7 describes the communities (external activity systems) that influenced OLC capacity to achieve professional learning goals. Section 8.8 describes how different approaches to developing OLC rules impacted on professional development within learning communities, and section 8.9 discussed the importance of learning community project management skills as an enabler of professional learning. Section 8.10 describes the impact different OLC management styles had on collaborative professional learning outcomes, and section 8.11 highlights the importance of goal setting and explicit OLC focus. Section 8.12 describes how shared values might impact on the capacity of a learning community to coalesce into a focused team of teachers, and section 8.13 describes the extent to which multiliteracies capacity in a learning community impacted on collaborative professional learning capacity. Section 8.14 describes the levels of data awareness observed in this study and the impact this had on professional learning in learning communities. Section 8.15 describes the enabling collaborative professional learning protocols and practices adopted by teachers during the study, and section 8.16 describes the extent to which teachers were able to use social networking skills to promote collaborative professional learning in their learning communities. Section 8.17 describes the extent to which OLC teachers had developed relationships of
8.2. Learning Load

This study showed that a manageable learning load was a characteristic of effective learning communities. The major sources of individual learning load were the requirement to know (1) the features and constraints of communication technologies; (2) how to create, develop and sustain learning communities; and (3) how to manage the operations of an online community. The teachers needed to master this knowledge before they could begin collaborative professional learning projects regarding teaching.

This study found there were 22 characteristics of successful learning communities. Literature reviewed for this study revealed some mention of the characteristics of effective online learning communities. These included leadership, institutional practices, the nature of learning activities, community cohesion, organisation of activities, group size, socialization, and interaction (Graham, 2007; Kapitzke & Pendergast, 2005; Kopp & Mandl, 2008; McGill, Klobas, & Renzi, 2011). However, few substantive details were provided about a general list of such characteristics.

Using technologies to support learning has, to date, been difficult to do well (Bull, Bell, & Hammond, 2008; Liston, Whitcomb, & Borko, 2009; Mishra & Koehler, 2006). The technological pedagogical content knowledge (TPACK) framework provides an indication of why adding technologies to a learning environment significantly increases the complexity and reliability of learning (Archambault & Crippen, 2009; Borthwick et al., 2008; Harris, Mishra, & Koehler, 2009; Pierson & Borthwick, 2010).

This thesis posits that teachers in learning communities needed to learn how to combine technologies with collaborative professional learning practices and operational procedures (as a pre-training activity) before beginning collaborative professional learning in a community. A properly designed pre-training activity would reduce the learning load that tends to be a burden to teachers by providing sufficient time and appropriate learning opportunities and resources to eliminate an overload.

No teacher in this study could afford to go without at least some pre-training, but the content and amount of the training required and undertaken varied greatly from one
teacher to the next. Teachers with a high learning load could easily be cognitively overloaded when they were expected to learn more than they were capable of learning in the time they had available to them (Mayer & Moreno, 2003; Paas et al., 2004).

Cognitive load reduction strategies are listed in the literature, and these might usefully be incorporated into professional development programmes. For example, distributed cognition and offloading are two techniques that are known to reduce individual loading on learners (Mayer & Moreno, 2003; Paas et al., 2004; Scardamalia, 2002). This study, however, found the most effective way to provide a managed learning load would have been to establish individual learning requirements at the beginning of the PD research, and then to develop individualised pre-training strategies designed to ensure all teachers reached a point where they had enough skills and knowledge to be able to participate in OLC activities before projects began.

8.2.1. Mapping Learning Load Tensions onto the AT Framework

The tensions that result from an excessive learning load for teachers may be mapped onto an AT diagram (see Figure 17 below).

The bold arrows of Figure 17 highlight the main sources of tension that contributed to increased learning loads for teachers; these included familiarity with the digital tools they should use (tools node); understanding of an evidence-based professional learning project protocol (object node); knowledge about how and when to collaborate or cooperate (division of labour node); the support they receive from their school (community node); and the operating procedures of their OLC (rules node).
Analysis of the results of the TPACKBRU questionnaire revealed that teachers began their professional development programme with a wide range of skills and knowledge. Some teachers had nearly all the skills, knowledge, and disposition required to participate in online collaborative professional learning, while others struggled to find ways to participate.

The evidence suggests most teachers, whether in low-performing or high performing learning communities, possessed many of the individual and shared values and predispositions that are known to promote collaborative professional learning (Correia & Davis, 2008; Foord & Haar, 2008). However, the “challenge” aspect of relationships of respect, and challenge (Little & Curry, 2009) were largely not evident in collaborative professional learning conversation transcripts. Some literature suggests the development of trust and respect comes about as the result of frequent interaction over time, and the capacity to challenge will then follow (Harmon-Jones & Mills, 1999; Timperley & Earl, 2009). However, in this study, there appeared to be something more going on; despite sometimes very frequent interaction between teachers, there were few challenge statements.

The absence of terms like disagree in a search of more than 20,000 conversation transcripts suggests these teachers were largely new to the notion of challenging alternative viewpoints in this Brunei context. The researcher believes the evidence points towards two primary factors that inhibit the development of challenge capacity in learning.
communities. Firstly, these Brunei teachers exist in a culture where agreement is a preferred safe contribution to a conversation, and where challenge of someone else’s idea may be taken personally. Secondly, it was clearly difficult at times for these English second language teachers to present a well-crafted and compelling argument to support a contentious view, and therefore, much easier to not contribute at all.

These teachers needed to be able to freely challenge views they disagreed with or didn’t properly understand, and they needed to be able to support their own arguments with evidence-supported, reasoned, discussion postings. The discovery of disagreements between teachers should have been celebrated as an opportunity for learning (Earl & Timperley, 2009a; Harmon-Jones & Mills, 1999), and not as a strategy that would increase personal risk of confrontation. If dissonance was more fully and frequently celebrated, it follows that data awareness and relationships would have become more important success factors for learning communities.

Nearly all teachers were familiar with online social networking tools, and in particular, Facebook. But they lacked knowledge of which tools to use for online social learning and community collaboration. When teachers communicated online, they overwhelmingly preferred to repurpose the tools they knew rather than add to their learning load by trying to learn new tools. However, teachers without an appropriate OLC toolset for collaboration had difficulty contributing to OLC activities.

CoP literature suggests that when a community first emerges it is in the potential stage of development (Wenger et al., 2002). The results of this study suggest this may not be true of learning communities; these will usually require a pre-training stage before being able to reach the potential stage of development. The Online CoP diagram (Figure 18) was developed by the researcher to reflect the ideas presented in the preceding discussion. It is an extension of a traditional CoP diagram that was previously presented in Section 2.5. The Online Collaborative Professional Learning Community Stages of Development diagram highlights the need for pre-training and also indicates that the developmental tension at this stage will be for community members to determine whether they have enough capacity to communicate online to be able to move on to the potential stage of community development.
The pre-training stage proposed by the researcher will vary in length and content to accommodate the varying requirements of teachers. The following suggestions for practice, some of which were followed in the professional development associated with this study, may help to ensure teachers are not overloaded with too much to learn at the beginning of a learning community programme.

1. It is important to accommodate teachers (as learners) who have different learning requirements, different preferred learning styles, and different rates of knowledge acquisition.

2. The Pre-training Learning Load Indicator (PLLI) (Table 46 in section 8.3.2) might be used to establish professional learning requirements when learning communities are first formed. Results would indicate both the content and duration of a customised community pre-training programme.

3. The Collaborative Professional Learning Community Development Indicator (OLCDI) (Table 7 in section 3.5) may be used to locate a learning community on a developmental trajectory and thereby inform the design of PD to advance OLC PLC capacity.

4. Teachers will need external support on an ad-hoc basis. A Twitter-based professional learning network may be supplemented with a website where teachers can view frequently asked questions and a knowledge base.
5. Teachers should make use of online video meeting tools (e.g. Google + Hangout, meetings.io, Big Marker, and join.me) to support initial socialization efforts through video conferencing. Socialization is an important part of community development (Salmon, 2005) and it is hard to do this when text is the only form of communication.

6. Start with easy projects designed to build community professional learning capacity before beginning evidence-based professional learning conversations.

The radar chart of learning community development (Figure 19) was developed during this study to reflect the increasing knowledge production capacity of a community as it worked through project learning processes. This radar chart shows three main interrelated sets of characteristics of effective online learning communities: community characteristics, individual characteristics and operational characteristics. At the beginning of their first project, a community of teachers may only have limited means at their disposal with which to complete their project. Over time, as teachers completed projects, they developed the knowledge, attitudes, skills, aspirations and behaviours that led to improved collaborative professional learning capacity. For example, the following table shows the development of a learning community (Table 45), and the corresponding radar chart in Figure 19 shows the same information presented graphically.

Table 45. Professional learning capacity development

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Project 1</th>
<th>Project 2</th>
<th>Project 3</th>
<th>Project 4</th>
<th>Project 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community</td>
<td>30%</td>
<td>40%</td>
<td>60%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Individual</td>
<td>50%</td>
<td>70%</td>
<td>80%</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>Operational</td>
<td>30%</td>
<td>50%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Table 44 shows that when this community completed project 1, it had 30% of the community characteristics associated with effective learning communities, teachers (individually) had, on average, 50% of the characteristics of effective communities, and the community had 30% of the operational characteristics associated with effective professional learning communities.
The small, innermost triangle (Figure 19) indicates teachers had only a subset of the operational (30%), individual (50%) and community (30%) characteristics associated with an effective learning community, but that teachers increased their capacity to learn collaboratively online over time. By the end of the 5th project this learning community had 80% of the community characteristics associated with effective professional learning, individuals had 90% of the individual characteristics of an effective learning community, and 60% of the operational characteristics of an effective community. See Table 46 for a list of the characteristics of effective learning communities mapped onto individual, community and operational dimensions.

The researcher’s view of how a learning community develops capacity to learn is supported in literature that suggests that teachers learn in complex systems, and that further learning is very much influenced by what has been learned or experienced previously (Opfer & Pedder, 2010).

“As teachers learn, new knowledge emerges from the interaction of the teacher learning systems, and this new knowledge then recursively influences future learning and also what is to be known about teaching.” (Opfer & Pedder, 2010, p. 388)

<table>
<thead>
<tr>
<th>Table 46. Group, individual, and operational characteristics of learning communities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group characteristics</strong></td>
</tr>
</tbody>
</table>

217
<table>
<thead>
<tr>
<th>Activity level</th>
<th>Inquiry minded</th>
<th>Leadership style</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outliers</td>
<td>Collaborative learning skills</td>
<td>Continuous improvement</td>
</tr>
<tr>
<td>Goal orientation</td>
<td>ICT</td>
<td>Project management</td>
</tr>
<tr>
<td>Relationships</td>
<td>Data wise</td>
<td>Protocol/process mastery</td>
</tr>
<tr>
<td>Community size</td>
<td>Learning Load</td>
<td>Tools</td>
</tr>
<tr>
<td>Community support</td>
<td>Self-Management</td>
<td></td>
</tr>
<tr>
<td>Visibility</td>
<td>Multiliteracies</td>
<td></td>
</tr>
<tr>
<td>Values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intentionality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-training</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Each of the 22 characteristics listed above is co-dependent upon other characteristics. For example, if a community fails to adopt project management related operational procedures, the learning load will be increased for individual teachers, the cohesion of the community may be put under pressure, and the intentionality of the community brought into question when desired outcomes are not able to be achieved.

8.3. The Online, Collaborative Professional Learning Community Model

The knowledge that community members benefit from knowing about when considering development of their collective learning capacity may be organised into three learning areas, as presented in the Online Collaborative Professional Learning Community Model Venn diagram (Figure 20). This model indicates that there are eight knowledge domains teachers in a community should know about; the three primary knowledge domains, knowledge at the intersections of these domains and knowledge about the environment in which online learning is to take place (context).
Figure 20. Online collaborative professional learning model

The specific knowledge areas shown in Figure 20 are briefly described as follows:

1. **Technology knowledge**: (Digital communication tools, Digital literacy). Knowledge about the digital communication tools that teachers can use when they are completing projects.

2. **Collaborative Learning**: (Goal orientation, Intentionality, Inquiry minded, Data wise) Collaborative learning knowledge includes knowing the procedures and practices that may be used to promote collective knowledge building, and that will sustain a community.

3. **Operations Knowledge**: (Community size, Community development strategies, Community assessment, Leadership style, Project management) Operations knowledge includes knowing the procedures and practices that support and sustain development of the community.

4. **Knowledge at the intersection of Technology Knowledge and Collaborative Learning Knowledge** (Contribution, Visibility, Multiliteracies). This is knowledge about how different digital tools can be matched with specific collaborative learning tasks. For example, it would include the use of a wiki technology to maintain a professional knowledge base.
5. **Knowledge at the intersection of Technology Knowledge and Operations Knowledge**: (Activity levels, Project management). This is knowledge about how teachers can use technologies to support the day to day operations of their community. It includes knowledge about project management applications, data capture and analysis tools, tools for maintaining an online knowledge base, and tools for generating transcripts of online communications.

6. **Knowledge at the intersection of Collaborative Learning Knowledge and Operations Knowledge**: (Collaborative learning skills, Relationships, Cohesion, Shared values). This is knowledge about how different operational procedures and processes can support collaborative learning processes. For example, when operations exist to record discussions then this provides data that can be used by a community to analyse the learning performance of their community, and to provide content for their professional knowledge base (wiki). This knowledge domain also includes knowledge about how communities develop, and the operational strategies that might be applied at different points on a groups’ developmental trajectory.

7. **Knowledge at the intersection of Technology Knowledge, Operations Knowledge and Collaborative Learning Knowledge**: (Visibility, Pre-training, Learning load, Continuous improvement) Knowledge about effective operational processes and procedures when using technologies for professional learning as well as how to manage of how to select suitable technologies to achieve collaborative professional learning goals while at the same time considering the importance of managing the community development goals as well as the practice-oriented professional development goals.

8. **Context Knowledge**: Knowledge about the opportunities and challenges that exist in the specific setting where teachers are to learn together. It includes an appreciation of the time available to teachers for professional learning, an appreciation of the support teachers might expect from institutions (such as their school and the Ministry of Education), and the expectations of other education stakeholders, including parents and students.

The above understandings may be used as the basis for professional learning content that develops the capacity of a community to participate in online learning.
8.4. Subjects and Tools

Nowadays, there is a view that learners pick up online tools and repurpose them for their own learning needs as and when required (Lund & Rasmussan, 2008; McGill et al., 2011). That view is contradicted by this research. Teachers, by and large, used the tools they were familiar with, irrespective of whether they were appropriate for the task at hand. These teachers indicated having very little knowledge of digital tools beyond the use of word processors, presentation tools, search engines, and Facebook — and then showed only limited understanding of the impact on professional learning that using some tools might have.

MA teachers were familiar with Facebook and believed that they could use it to complete projects. However, towards the end of projects, teachers needed to evaluate how their project activities contributed to their professional learning, but found they had very little evidence to draw on for this purpose. This was because Facebook doesn’t normally generate the transcript data required by teachers to evaluate their professional learning, and it doesn’t have a facility for storing the collective knowledge of a team of teachers.

The LU community teachers did not use Facebook, in part because the two primary community contributors (LU-1 and LU-5) did not have Facebook accounts. Instead, LU teachers used SMS to supplement Moodle communication activities. SMS was used to message teachers whenever a contribution was made to a project discussion. The results show that using SMS was an effective strategy for informing community members when they had a new discussion posting to respond to. The reduction in learning load occurred because discussions could be concluded more quickly, and therefore, teachers were less likely to have a large number of incomplete project activities towards the end of the time they had available.

It is possible to reduce learning load by ensuring the communication tools teachers use are fit for purpose, and by ensuring the teachers themselves know how to choose such tools (Lund & Rasmussan, 2008). The right combination of tools will communicate information in multiple modalities, which in itself is known to reduce learning load through an off-loading effect (Mayer & Moreno, 2003). Discovering new tools and learning how to use them was challenging for the participants in this study. It is perhaps the case that teachers needed to learn how to select tools and that this in itself might have been set as a learning goal of the PD programme.
There is literature that argues that teachers of today are digital natives, meaning that they were brought up with digital technologies, and therefore, they might be able to learn new tools effortlessly (Borko, Whitcomb, & Liston, 2009; Lund & Rasmussan, 2008; Prensky, 2001). It may also have been the case that some younger teachers mastered the mechanics of intuitive user interfaces more quickly than older teachers, in part at least, because of previous exposure to such technologies. However, in this study, results support an argument that teachers, irrespective of age, did the same things and spoke the same language when they wanted to. There was no evidence found to suggest age was a variable that might explain differences in individual performance, or in particular, that older teachers were less likely to be able to learn new tools. Therefore, these results do not support an argument that either digital natives or digital immigrants were better able to repurpose new technologies (Prensky, 2001). The research, therefore, favours a growing body of evidence that dispels the notion digital natives and digital immigrants are dichotomous generations (Helsper & Eynon, 2010). What was universally problematic amongst community teachers was an understanding of how to select best of breed tools that were suitable for specific community tasks. This failure to effectively choose tools increased the workload, and subsequently, the intrinsic cognitive load of participants.

There is a large amount of learning load at the beginning of an online collaborative professional learning programme, and professional development providers do need to build strategies into their courses that reduce the chance the participants might be overloaded. The consequences of high levels of learning load at an early developmental stage of a community were severe. Individuals who did not learn the prerequisite skills, knowledge, and predispositions to participate in activities could not interact with others in online activities, and thereafter, failed to participate in community activities at all.

8.5. Subjects and Object

The motivation of teachers to participate in their OLC was driven by their finding value in participating in an evidence-based professional learning conversation. There was a tension between the subject node and the object node that continually needed to be balanced by community teachers. Some learning communities were not operationally organised to promote high levels of professional learning within their group. They did not set aside enough time for project activities; they sometimes preferred to cooperate rather
than collaborate during activities; and sometimes, they focused on producing the artefact
products of a project rather than learning through engagement in the processes of projects

There is every indication from analysis of reports and from analysis of discussion
transcripts that the MA teachers understood the project completion guidelines very well.
The MA teachers held open and frank discussions with participation by all members of
the community. There were no forceful agents dominating discussions in the MA group.
Forceful agents tend to interfere with knowledge aggregation to the point where they may
spread misinformation in their network (Acemoglu et al., 2010). However, the MA
teachers were able to challenge the views of other teachers, and consensus was evident in
both discussion transcripts and MA reports.

The MA teachers knew how to evaluate their own online collaborative professional
learning performances, and altered their operational procedures where they thought there
was an opportunity to improve the way their community attained learning outcomes. On
one occasion, to ensure MA teachers participated in discussions in a timely manner, they
decided that the last person to contribute to discussions would have to write up the
capstone project report required at the end of the project. On a second occasion, having
initially decided not to have a community leader, MA teachers eventually decided upon
the need for an organiser. They determined that the role of the organiser was to ensure
project activities were completed on time, and that all MA teachers met deadlines. MA
teachers clearly got better at collective knowledge building as they progressed through
successive projects. By September 2011, the MA teachers had reached a stage of
development akin to the highest level of the Model of Teaching and Learning Online
(Salmon, 2005). In terms of learning load, the MA teachers were in the ideal position of
being able to concentrate on project activities.

Overall, the MA teachers had enough germane cognitive load capacity to be able to
participate effectively in project activities. However, they did have some undesirable
intrinsic cognitive load that was brought about by their propensity to leave project
activities to the last minute.

Intrinsic cognitive load might have been reduced by a combination of strategies including
better planning (project management), selecting best of breed tools instead of overly
relying in Facebook, and by networking with people in external activity systems so they
could learn things the community could not easily learn on its own.
The MA teachers were also subject to extraneous cognitive load, particularly from their workplace. Teachers in this study were challenged by the introduction of the Brunei Common Assessment Tests (BCATS), a new assessment system (introduced in 2011) that was both time consuming to learn and difficult for them to implement. Teachers were not provided with any time allowance to complete their professional development programme, and found they had insufficient time to do as much as they wanted in the way of project activities.

Workplace Internet connectivity was almost universally problematic; therefore, online activities took longer to complete than necessary as some teachers were forced to wait until they had access to the Internet at their homes before they could participate in community activities.

The LU teachers had no difficulty with the project teaching investigation steps. LU-1 and LU-5 demonstrated a very good understanding of how to trial a new classroom practice and then evaluate the extent to which it was successful. However, the LU teachers never once changed their operating procedures as a result of meta-cognitive activities; an indication, given the difficulties the LU community faced, that insufficient attention was given to evaluating community learning performance.

The LU community appears to have had at least one forceful agent who tended to make quite strong statements in discussions that went unquestioned by other teachers. An unwillingness to challenge the views of the forceful agent resulted in few contributions to conversations by anyone other than the forceful agent, with a resultant limitation of general collaborative learning opportunities for all members of the LU community.

The forceful agent may have presented a view that was not necessarily accurate, but one that became the community view in reports. Thus, it was possible the forceful agent was in part responsible for propagation of misinformation that was ostensibly representative of the views of all members of her community. Both the forceful agent and the lack of a reliable knowledge base represented challenges to the on-going cohesion of the LU community.

By September 2011, the LU teachers were still at stage 1 of the model of teaching and learning online. There is insufficient evidence of interaction between all but two members of the LU group to justify a determination otherwise. High learning loads seemed to have
been a barrier that dissuaded LU teachers from participating in project activities at the beginning of the programme, and these teachers never seemed to get beyond that state. The unequal presence of LU teachers in project activities increased the activity load of LU-1 and LU-5 to the point that they adopted strategies that limited opportunities for any collaborative professional learning. They too mentioned how their attention was split between having to learn and implement BCATS while participating in a PD programme at the same time.

8.6. Subjects, Collaboration and Cooperation

The MA teachers knew when and how to collaborate to build collective knowledge. Web tracking statistics, project reports, and project discussion transcripts reveal the MA wikis and discussions were jointly developed by all MA members. Some activities, assigned to individuals, were completed individually, such as collecting data from MA teachers’ classrooms, and project report production; however, there is clear evidence the MA teachers knew when to distribute tasks to individuals and when other tasks needed to be completed collaboratively. All members participated in all collaborative knowledge-building activities. It appears the MA teachers collaborated and cooperated in ways that ensured germane cognitive load capacity was at high levels, and therefore, available for professional learning.

The LU teachers cooperated very well to the extent that their project tasks were allocated to individual participants. For example, one person in the LU group almost singlehandedly completed wikis, while another was frequently the main contributor to discussions. However, this produced a cognitive underload for most LU teachers, as their opportunities to interact in knowledge building activities were limited. There was evidence of division of labour being practiced by LU-1 and LU-5, and it does seem, on the whole, the remaining four members of the LU group left these teachers to complete all the activities between them. Therefore, LU-2, LU-3, LU-4, and LU-6 were cognitively underloaded to the point where it would have been difficult for them to learn professionally.

8.7. Subjects and External Activity Systems

All community teachers were subject to extraneous cognitive load by their schools. School administrations and the Ministry of Education in Brunei were supportive of the
online collaborative professional learning programme, and picked teachers to attend it. However, at the same time, they placed some teachers in multiple professional development programmes running at the same time, and made no allowances in terms of workload for teachers engaged in online collaborative professional learning. In addition, schools required teachers to attend meetings and other extraneous activities at times they were scheduled to attend online collaborative professional learning workshops. Such conditions unnecessarily loaded teachers with more learning than was necessary or useful when they had to try to catch up with work they had missed. To illustrate this, one teacher referred to feeling “blur” about which professional development programme she was attending while sitting in a workshop, such was the demand on her time to be in different places at different times.

8.8. Subjects and Rules

The notion of rules was opposed by the majority of teachers in this study. It seems, in the Brunei educational setting, the concept of rules has a definite negative connotation. Teachers frequently commented that their learning communities did not set rules. However, at the same time, most learning communities developed operational procedures designed to ensure the completion of tasks — rules by a different name:

MA report comment August 2011

Our group does not have a specific rule but we have always followed the rule where we complete everything but the very last person to complete all of the discussions & wiki will be doing the report. It has helped our group to complete all of our tasks so far and hopefully this rule will continue to help us in any of our future tasks. Discussions would have been better with rules but we still discussed through Facebook because it was more convenient. No rules were set except for our golden rule where the last person will be the one to complete to wiki and reports

MA teachers established operational procedures (rules) for completing project activities. Rules were created reflexively as and when needed. For example, having found themselves pressed for time, MA teachers created a rule that made it necessary for all MA teachers to make at least one posting to each Moodle discussion. This helped to ensure that discussions were completed in a timely manner.
As the MA community evolved over time, so did the rules its members decided needed to be in. The MA teachers changed their professional learning community operational procedures to better match the changing circumstances within their community. This changing of rules may be interpreted to be a healthy sign that the OLC is indeed considering how to better manage their activities.

The LU teachers did not appear to develop rules to the same extent as the MA teachers, and did not create or modify rules that might have improved the way LU teachers collaborated to produce professional knowledge. As the following quote suggests, not all teachers were in favour of establishing operational procedures of any sort.

21 August 2011
06:20 P.M.
LU-5

No rules were created to enable our LU Group to function more effectively, so that we all share our burden together, whether we are successful or fail towards the end we all sail in the same boat, if we safe we enjoy our success, if we fail, we all sink down together.

It is apparent that rules may be necessary for community functioning (Barab et al., 2004). According to Benson et al. (2008), a community will develop its own operational procedures to support development of and sustainment of the community. Both CoP theory and project theory mention the need for operational procedures to ensure participants manage to complete all activities. According to CoP theory, operational procedures are developed during the maturing phase (see section 2.5.3). The community rules are effectively fixed at that time. Revised operational procedures are a likely output of project activities, and therefore, the rules of a community are modified frequently throughout the lifetime of the community. As a community evolves, some rules will become outdated, and new rules may be required.

A PLC has well-defined standard operational procedures designed to ensure a team of teachers will achieve professional learning goals:

“Very importantly, everyone operates within a built-in system of accountability because they are expected to contribute to the continuous improvement of their team and their school.”

(Richard Dufour et al., 2008, p. 170)
Such procedures are mandated by a community and are not reviewed in a project setting. In a community, operational procedures are continually being revised and renewed to reflect the evolving nature and needs of the community.

The implementation of rules by the MA teachers ensured that germane cognitive load was maximised, while the application of rules by the LU group maximised extraneous and intrinsic cognitive load while it minimised the germane cognitive load that should have been available for professional learning.

8.9. Project Management Skills

Teachers as project managers, in the context of this study, aimed to do the minimum amount of planning at the latest possible time while ensuring the professional learning aspirations of the community were achieved. Additionally, good project managers looked for ways to streamline community workflow and learning by evaluating past projects so that the community steadily improved its effectiveness and efficiency. Some of the typical project management activities teachers might need to deal with are (1) managing the roles of people in the community; (2) acquiring resources (perhaps external expertise); (3) estimating, scheduling, and planning; and, (4) risk management (Ambler, 2005; O'Brien, 1999).

The evidence-based professional learning project protocol — used by the teachers as a roadmap for completing projects — was complex and time-consuming to complete. Some activities were best completed by all teachers collaborating synchronously, while other non-learning activities might be delegated to individuals.

The AT diagram below (Figure 21 ) shows the main project management tensions exist between the Subjects, Rules, Object, and the Division of labour nodes.
No teachers in any OLC demonstrated knowledge of project management; yet the projects they embarked upon had sufficient tasks, resources, and time management components to justify the use of project management tools and techniques. Results from this study showed projects fell behind time with a resultant rush to complete work towards the end. If teachers had taken it upon themselves to collectively manage their projects (using appropriate project management tools and techniques), there is every reason to believe they would have been able to complete a large numbers of project tasks before the last minute. By insisting on collective cognitive responsibility (Scardamalia, 2002) for project management, the quality of project management decision-making might be expected to be higher than if one person alone had responsibility for it — and buy-in to meet project deadlines would have been greater than it was. The impact project management might have on the outcomes of a project are illustrated in the following quotation:

They recognize that their employees may be carrying out overt tasks with a high level of responsibility, but that things keep going wrong or projects deteriorate because problems are either not being recognized or are thought to be someone else’s responsibility. The calendars, to-do lists, and project management software designed to keep people organized and on task provide little help in this regard. They may include cognitive items—“Decide...,” “Look into...,” “Plan...”—but these have the effect of limiting cognitive responsibility to particular people and of obscuring the continual living with problems and ideas that is part of the work life of an expert team (Scardamalia, 2002, p. 2).

There was no explicit mention of the need for project management skills found in either CoP or PLC literature. However, given the structured nature of PLCs, and the top down
support and direction provided to PLCs in schools, it is reasonable to suggest there was school administrator oversight of PLC projects (Foord & Haar, 2008). Given the individual variation between learning communities, it would make sense that project management responsibility should lie with those who best understood the challenges of their own unique learning environments: the teachers themselves.

8.10. Management Style

Two generic management styles were adopted by the different learning communities. Some learning communities, of which LU was one, chose a leader and allowed that leader to decide what people in the community should do. Other learning communities, such as the MA group, employed a consensus (horizontal) management style. The MA teachers were satisfied that sharing responsibility for decision making was the best practice for their community.

The traditional hierarchy management structure makes the leader a potential single point of failure. With more horizontal hierarchies and expertise distributed throughout a community, and amongst teachers who genuinely collaborate to achieve team goals, there is a tendency for 1) less dependence on individuals, 2) greater rates of transfer of expertise to all community members, 3) consideration of design alternatives rather than adherence to the solution proposed by a single person, and 4) the capability to access and use expertise that is a part of collective knowledge rather than knowledge held only by one person.

The AT diagram below (Figure 22) shows results from this study indicate the main leadership style tensions exist between the Subjects Node, Rules Node and the Collaboration and Cooperation Nodes.
The MA teachers used a consensus (horizontal management) style of leadership. They did not want to have a leader, although they later realised the importance of having someone designated to keep an eye on activity completion and the duration of activities. The MA approach to decision making was effective as teachers bought into the decisions they synergistically had a part in making.

In contrast, the LU teachers had a leader and adopted a traditional hierarchical management style. Some LU teachers seemed to be happy with this style of decision making — it was something they were familiar with and used to; some LU teachers reported feeling comfortable about being assigned tasks to complete by their OLC leader. Two LU teachers, with the best of intentions, and disastrous consequences, took on the responsibility for completing most community leadership roles and responsibilities, as well as most OLC activities.

Strong leadership and organisation was reported to be a success factor for PLCs (teams in face to face meetings in a single school) (Graham, 2007). However this type of leadership was often external to the PLC and came from school administration. Teachers in this study, mentioned their dissatisfaction with having a leader per se, perhaps because in the cultural setting of this study, a leader is viewed as someone who delegates work rather than as a member of a team that shares work. Consensus-based decision making
was effective in learning communities, perhaps out of necessity as there was no obvious, single, supporting leadership role present outside the OLC to lend guidance.

There are other reasons for not supporting the notion of a learning community leader (hierarchical management style) in a Brunei OLC. The leader may lack sufficient knowledge or experience of leadership to fulfil such a role effectively – if such a role could be defined in the first place. Additionally, the small learning communities of teachers that formed the research groups could ill-afford to use one of their members in a leadership role; doing so would reduce the number of people contributing to the community’s collaborative professional learning activities.

8.11. Explicit Goals and Focus

There is ample evidence in Community of Practice theory (CoP) of the need for teachers in learning communities to agree on shared professional learning goals (Richard Dufour et al., 2008; Graham, 2007; Lund & Rasmussan, 2008). The following AT diagram (Figure 23) indicates in this study, goal setting and community focus were influenced by (1) the skills, knowledge, and dispositions of community teachers; the influence of external activity systems on OLC; (2) the willingness of teachers to collaborate and cooperate to complete collaborative professional learning activities, and (3) teachers understanding of how to navigate an evidence-based professional learning project protocol.

![Figure 23. Explicit goals and focus tensions](image_url)
8.12. Values

“Commitment to a shared mission, vision and goals requires alignment to our values as well.” (Foord & Haar, 2008, p. 70)

Shared values are at the heart of an online learning environment (Arnon & Reichel, 2009; Barab et al., 2004). Common values are an important consideration when participants are selected for either CoPs or PLCs (Richard Dufour et al., 2008; Foord & Haar, 2008). This being said, it is not sufficient to have similar values; what is necessary is that learning communities have shared common values that relate specifically to online collaborative professional learning. The local culture may influence these values, as some research indicates teachers from a number of non-western cultures may neither support nor appreciate their own views being challenged, and they may feel uncomfortable about being a critical friend to their colleagues (Wachob, 2010).

The following AT diagram (Figure 24) indicates that individual and community values influence the extent to which teachers are able to collaborate, and thereby, the extent of overall professional learning. The only node operating in this analysis is the Subjects node. The shared values of a community will influence the extent to which collaboration and cooperation can take place, and may also influence the extent to which there is the drive within the OLC to complete projects.

![Teacher Values AT Diagram](image-url)

**Figure 24.** Teacher Values AT Diagram
The results of this study were aligned with current CoP and community literature and support an argument that the value sets of individuals in a community need to be compatible. The values of individual MA teachers were compatible with those of other teachers in the group, and the community values were agreed upon by all members.

Results presented in sections 8.5 and 8.14 show that both LU and MA teachers had shared values that supported online collaborative professional learning.

**8.13. Multiliteracies**

Multiliteracies is the capacity to communicate using a range of different modes of digital communication. Multiliterate community teachers are able to accurately interpret messages from other teachers and convincingly elaborate their own position on issues. Multiliteracies goes beyond having a nuanced understanding of text to include familiarity with the norms of communication using a variety of tools (Hammett, 2007). In addition, (Wright, 2010) suggests being multiliterate involves being able to think critically about what people are intending to say when they communicate in different modalities:

… It is the development of the facility to understand aspects of texts such as agency, motivation, gaps and silences, and political and economic agendas. It is also about purposeful and reflective judgement, involving determining meaning and significance of phenomena, including different kinds of texts. (Wright, 2010, p. iii)

Wright describes the ability of learners to integrate digital tools into authentic learning opportunities as a significant success factor in online environments.

The following AT diagram (Figure 25) shows that multiliteracies tensions are influenced by the tools teachers have to use; that collaboration and cooperation are limited by the capacity of teachers to communicate effectively with each other; and that teachers need to be multiliterate to participate in collaborative professional learning processes and to produce digital artefacts (presentations, workshop sharing sessions, and capstone reports) that are accessible to audiences in external activity systems. Levels of multiliteracies amongst community teachers in both groups were somewhat limited to the use of text-based communication in the social networking environments with which they had prior experience.
The MA teachers used the Moodle discussion and wiki facilities available to them, but repurposed Moodle functions to suit their style of working. The online discussions in Moodle became a place where the MA teachers recorded a summary of discussions they had held elsewhere rather than using it as a primary venue for discussions *per se*. These participants did not provide evidence of having considered a significant range of tools to bring to the projects, or indeed, any tools other than those with which they were already familiar.

The use of Ishikawa fishbone diagrams (see section 9.2.3) was a notable exception to teacher preferences for the use of familiar tools. It is, therefore, reasonable that the extent to which these teachers were multiliterate was linked to their *willingness* to seek out new tools that might help them to be a better OLC participant.

### 8.14. Data Awareness

Data awareness was an issue for all teachers in this study. There is a good deal of support for the notion that teachers should be engaged in self-regulated learning guided by metacognition, strategic action, and motivation to learn (e.g. Cox, 2008; Loucks-Horsley et al., 2003; Scardamalia, 2002). In part, or as a consequence, there is considerable support for the notion that for teachers to perform as reflective self-regulatory learners, they should be (Earl & Timperley, 2009b; Hirsh & Killion, 2007; Killion, 2008; Mandinach & Honey,
In this study, participants were unaware of the tools they might use during data analysis, and they lacked experience and knowledge about evidence-based investigations. Analysis of reports completed at the end of projects showed that teachers mostly used Excel to produce descriptive statistics and to produce charts to represent their investigation findings. Therefore, when teachers presented their findings in an external activity system setting, such as when they made presentations at sharing sessions, they had only limited capacity to present convincing arguments that might lead others to try out their problem solutions.

The following AT diagram (Figure 26) shows the main data-awareness tensions present in the activity systems studied in this research. There were tensions within and between five nodes that required continual balancing within the activity system.

![Data awareness tensions AT diagram](image)

**Figure 26.** Data awareness tensions AT diagram

Limited data awareness had a number of likely consequences. Firstly, it was not possible to build a reliable community knowledge base because the outcomes of Projects were not rigorously tested. Secondly, teachers were unlikely to be convinced by untrustworthy project results, and therefore, were unlikely to change beliefs about their own practices. Thirdly, if there were teachers in a community who were data aware, it is possible they were delegated the responsibility for data analysis tasks. The consequence of this was that other teachers never had the opportunity to develop data awareness themselves.
To avoid the consequences of uneven distribution of data processing capacity amongst community teachers, it was necessary to provide external support in the form of data awareness training to those teachers who requested it.

The tools for data capture, processing, and results presentation were at best partially accessible to teachers. Excel, gNumeric, and online chart production tools were used by different learning communities at different times, but none of these was straightforward for teachers to use. This then led to the need to spend time learning data analysis tools (intrinsic cognitive load) instead of spending that time on their teaching practice investigation.

8.15. Collaborative Professional Learning Skills

There is no doubt that collaborative professional learning is an effective form of professional development; however, given that the participants in this study were largely unfamiliar with collaborative professional learning, it was important they experience early success with it, because it is only after such successes that their beliefs might be changed (Guskey, 2002). Groups such as MA experienced such success; they gained a good deal of new knowledge they could apply in their classrooms, and also discovered they could learn collaboratively online.

On the other hand, not all of the LU teachers experienced opportunities to participate in the project activities that promoted individual learning; therefore, this group of teachers did not experience early successes that would have helped the community to bind together as a team.

One important aspect of collaborative professional learning is an understanding of the difference between collaboration and cooperation (Duncombe & Armour, 2004). In this study, the participants needed to understand that sharing resources and opinions was not the same as the synergetic discussion that might challenge long-held beliefs (T. Anderson, 2004; Angeli, 2008; Moroney & Haigh, 2010).

The AT diagram below (Figure 27) shows collaborative professional learning capacity to be influenced by the tools teachers use; the types of activities (Object) teachers engage in; the extent to which teachers adopt collaborative practices instead of cooperative practices; and by the rules that community teachers set for themselves.
Results show that the teachers in this study were very good at cooperating with other teachers in their daily work. They readily distributed a department workload by subdividing and allocating tasks to department teachers. On the other hand, all teachers were unfamiliar with collaborative practices in the workplace and indicated they had little or no experience of collaborative learning. Therefore, the capacity of teachers to participate in collaborative professional learning depended upon the learning they had access to during pre-training. If, as was the case for the LU teachers, they had a heavy learning load, it may be these teachers did not properly learn procedures and practices that would help them to learn effectively; the results of this study certainly support such a supposition.

8.16. Social Networking

Socialization is an important activity during initial developmental stages of a community. The purpose of the socialization process was to build an initial sense of community and cohesion.

The following AT diagram (Figure 28) shows the tensions associated with online social networking were limited to the subjects, tools, and division of labour nodes.
The types of social networking teachers could participate in was determined by the availability of mediating artefacts — including the use of linguistic code switching — that helped to eliminate the differences between teachers who had varying English language literacy skills. Appendix K presents a discussion transcript that contains a significant amount of linguistic code switching.

It was easier and more effective for teachers to write messages in MalEngTex instead of Standard English; such messages were more accessible to an audience of community ESL teachers. These results show use of linguistic code switching was a success factor that helped community teachers achieve their professional learning goals.

The extent to which participants could engage in social networking depended on the tools they had at their disposal. Text tools (e.g. SMS or Facebook) were less effective than video conferencing tools (e.g. Vsee, ooVoo or Google + Hangout) for supporting efforts to build trust and purpose in a community. It was easier for teachers to understand each other when they were video conferencing because they were then able to pick up verbal and visual cues to support their interpretation of the message they were receiving.

The MA teachers had communicated with each other online for years. They had clearly developed the capacity to speak and be understood, as well as having an awareness of the content of postings that would be acceptable to the rest of their community. The LU
teachers were still establishing the limits of what could reasonably be said online, and were occasionally still overstepping those limits in September of 2011.

8.17. Relationships of Respect and Challenge

Relationships of respect, trust, and challenge are necessary for collaborative professional learning to succeed. This is especially the case when teachers participate in Projects (Earl & Timperley, 2009a; Little & Curry, 2009; Timperley & Earl, 2009).

The following diagram (Figure 29) highlights the results of this study and shows that relations of respect, trust, and challenge are influenced by the tensions within and between the subjects node and the division of labour node.

![Figure 29. Relationships of Respect and Challenge](image)

Although all teachers in this study demonstrated they were very good at maintaining consensus within online discussions, it is apparent the skills for conflict resolution were often replaced by the skills of conflict avoidance; the consequence of which was teachers did not challenge the views of others, and therefore, the opportunity for learning through exploration of recognised dissonance was lost.

Conflict resolution is a normal and integral part of conversations between teachers engaged in professional development in a PLC (Graham, 2007). Perhaps, in some cultural settings, it may be necessary for a learning community to make an extra effort to ensure
that within the culture of the community there is support for recognising a variety of viewpoints, and encouragement for those willing to put forward their ideas.

There were some unpredictable consequences of the avoidance of conflict practice adopted by the LU teachers. Teachers who did not agree with online postings simply reduced their online presence rather than challenge the contributor; thereby lowering the number of active LU teachers in a discussion — often below what was in this study a sustainable minimum community size of four active members.

The following table presents a brief summary of the relevance of the themes that emerged in this discussion, as they refer to the first research question that was answered in this study:

**Table 47. Support for learning community characteristics**

<table>
<thead>
<tr>
<th>Community Learning Theory</th>
<th>Professional Learning Community</th>
<th>Community of Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support for theory</td>
<td>Support</td>
<td>Contradict</td>
</tr>
<tr>
<td><strong>Community Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Activity level</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>2 Outliers</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>3 Goal orientation</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>4 Relationships</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>5 Community size</td>
<td>N</td>
<td>C</td>
</tr>
<tr>
<td>6 Community support</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>7 Visibility</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>8 Values</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>9 Intentionality</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>10 Pre-training</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Community Member Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Inquiry minded</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>12 Collaborative learning skills</td>
<td>P</td>
<td>C</td>
</tr>
<tr>
<td>13 ICT</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>14 Data wise</td>
<td>P</td>
<td>N</td>
</tr>
<tr>
<td>15 Learning Load</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>16 Self-Management</td>
<td>C</td>
<td>N</td>
</tr>
<tr>
<td>17 Multiliteracies</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td><strong>Community Operational Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 Leadership style</td>
<td>C</td>
<td>P</td>
</tr>
</tbody>
</table>
Of the 22 characteristics of effective communities, 36 percent are not mentioned in either the CoP or PLC theory reviewed for this study, and 23 percent contradict an explanation of the learning communities investigated in this study (see the bottom of Table 47).

It is not that reliance on PLC or CoP theory might limit development of learning communities, it is more the case that such reliance would, in some instances, actually damage or ruin community effectiveness and opportunities to develop. This evidence strongly suggests it is unrealistic to rely on an extension of either CoP or PLC theory to explain learning communities. Some parts of alternative theories contribute substantially to an understanding of learning communities.

Collaborative professional learning theory, Cognitive load theory computer supported collaborative learning theory, distance learning theory, and dissonance theory have all been used to contribute to an understanding of learning communities. Additionally, distributed cognition and cognitive responsibility have surfaced as important concepts that add to an understanding of learning communities. The main findings of this study answer questions about how learning communities form in their initial stages of development rather than how individuals might become members of a learning community, as is the case in many apprenticeship studies.

8.18. Summary

The purpose of this chapter was to discuss the findings in Chapters 6, 7, and 8 in terms of Community of Practice theory and Professional Learning Community theory. The chapter began with a summary of the challenges teachers faced when their learning communities first came into existence. Teachers needed to acquire a number of technical skills, knowledge, and predispositions, and also needed to go through a socialization process to build cohesion and trust within their learning communities.

The results of this study also highlighted the need for teachers to have access to individualized pre-training on a need-to-know basis so they can fully participate in project activities.
The next section described the difficulties teachers had with the tools available for online, collaborative, professional learning, and how they repurposed tools they were familiar with to conduct project activities. The tools participants selected solved one problem, but created other intractable problems that prevented access to the data they needed in order to be able to analyse the well-being of their learning communities.

Teachers mentioned the difficulties they had participating in professional development while under unrelenting work pressure. Some of this pressure may have been released if the teachers had used a range of project management techniques and tools to manage time, resources, the completion of project activities, and people. Difficulties may also have been reduced by negotiating common goals, improving focus, and clearly stating community objectives. All teachers in the MA group participated in discussions about choosing a problem to investigate (focus), while two LU teachers decided what their community would be investigating.

The Pre-training Learning Load Indicator (PLLI) was successfully used to identify the content of individualized pre-training required by community teachers. The results of using the PLLI provided information about the strengths and weaknesses of a community, and thereby indicated what might be done to make it work.

Two very different community decision-making processes were observed: a consensus-based approach that worked very well with the MA community, and a hierarchical approach that did not appear to support the professional learning goals of the LU community.

This study provided a report of the creation, development, and on-going functioning of learning communities. The 22 characteristics of effective online learning communities may usefully be considered when mapping professional learning trajectories when teachers are expected to learn together in small online teams.

The next and final chapter presents the conclusions of this research study; it provides answers to the research questions, conclusions about the research problem, suggests implications for theory, and provides implications for policy and practice.
Chapter 9. Conclusion

This study found an online, collaborative, professional learning community (OLC) to be an exceedingly complex entity subject to tensions — both internal and external — that influenced its capacity to meet the professional learning needs of its members.

Communities that demonstrated meta-cognitive tendencies emerged with an ever-increasing capacity to develop collaborative professional knowledge. The developmental trajectories of individual communities were unique, and the capacity to develop collaborative professional learning skills and knowledge was strongly influenced by the prior learning and experiences of community members.

Cultural historical activity theory (AT) was successfully used as a powerful tool for evaluating community learning capacity, and thereby provided community teachers with the potential to operationalize self-regulated learning informed by meta-cognition. Before this study, no existing theory satisfactorily explained OLC creation and development. This knowledge gap has been addressed by adding substantive new data to an emerging theory of online, collaborative, professional learning.

A model was developed to explain the interaction and interdependence of technologies, collaborative professional learning methods, and the operations required to create and sustain learning communities. There were 22 success factors identified in this study as critical for community creation and development. Some of these factors were previously unreported and others contradicted prior collaborative professional learning literature. Newly developed community assessment rubrics, questionnaire, and data capture/analysis methods will add substantively to an understanding of the tools required to operationalize learning communities.

9.1. Introduction

Although for many years there have been increasing numbers of studies examining collaborative professional learning as a form of continuing professional development for teachers, few have investigated online, collaborative, professional learning communities (Learning communities). Absent from the literature is research regarding the extent to which commonly applied offline, collaborative, professional learning theories, such as Community of Practice (CoP) and Professional Learning Community (PLC) may now be extended to explain online, collaborative, professional learning by teachers learning together in small learning communities. The present study has addressed this gap in the literature.

In this chapter, the author will provide answers to the research questions, indicate how the study has contributed to scholarly knowledge and research methodology, and then outline implications for policy and practice that arise from the findings. Suggestions for further research are then made, and the chapter finishes with a concluding statement.
This study had two phases: an initial preliminary study and the main one. The single activity in the preliminary study was to develop and validate a contextually appropriate, technological, pedagogical, content knowledge questionnaire that would also provide cultural and historical information about the research participants.

For the main study, the validated questionnaire (Moroney & Haigh, 2010) was administered in February 2011 and again in September 2011. The resultant analysis of the questionnaire helped to define the setting for the study.

The results of the survey indicated that although nearly all participating teachers owned laptops, a significant proportion of them had difficulty gaining access to the Internet; they indicated regular use of Facebook; and they mentioned using a number of websites to acquire resources for teaching and learning. However, there was no evidence they used any technologies for collaborative learning. The range of technologies these teachers were familiar with, and knowledge of how best to use them for their own collaborative learning activities was therefore limited.

9.2. Answers to the Research Questions

This section presents the answers to the two research questions of the study:

The two questions are:

1. To what extent do the collaborative professional learning characteristics identified in community of practice and professional learning community literature apply to communities of learning in the online environment?

2. To what extent may web tracking statistics be used to locate an online, collaborative, professional learning community on a developmental trajectory?

The answer to the first question determined that “traditional” community of practice theory and professional learning community theory do not satisfactorily explain how online learning communities are created, develop, and are sustained. Overall, it is apparent that prevailing explanatory models for collaborative professional learning require significant modification where the environment for the professional learning is online rather than face-to-face. The answer to the second question revealed that web tracking provided real time indications of teacher participation in communities, but that such information was found to be somewhat misleading at times. Teachers were
found to be quite innovative and creative in the way they used tools. In one instance teachers used online discussion facilities to summarise what they had learned elsewhere rather than as a discussion forum *per se*. Such creative use of technologies confounded attempts to use web tracking statistics to forecast learning community performances.

9.2.1. **Answer to Research Question One**

To what extent do the collaborative professional learning characteristics identified in community of practice and professional learning community literature apply to communities of learning in the online environment?

The results of this study show that: *goal orientation, cohesion, shared values, and intentionality* are characteristics of successful learning communities. These four factors are supported in both CoP theory and PLC literature (Foord & Haar, 2008; Wenger et al., 2002). The reader is reminded that Table 49 in section 9.17 presents a summary of critical success factors for learning communities as they relate to CoP and PLC theory.

Three learning community characteristics; *activity level, contribution, and relationships* — were only partially explained by these two theories.

From the *activity level* and *contribution* perspective, a learning community is collectively as well as individually active, as members of such a community are equals, and it is expected all will participate frequently and equally.

Both CoP theory and PLC theory mention that high levels of activity are important for learning. However, in a traditional CoP, it is more often the case that knowledgeable professionals — *old hats* — will share tacit knowledge about professional practice with newer community members. This implies that an apprenticeship relationship exists between newer CoP members and established CoP members. However, no such apprenticeship relationships existed in any of the communities of teachers in this study given that they all joined a new learning community at the same time.

Learning theories stress the importance of trustful relationships between community members, and suggests appropriate mechanisms to resolve conflict associated with differences of opinion. For learning communities to be successful, the relationships
between teachers need to extend to being trustful and respectful of each other, and to acceptance that views should be open to challenge. The occurrence of differing viewpoints amongst members of a learning community is welcomed and celebrated as presenting opportunities for community learning rather than as a situation to be defused.

The leadership style and continuous improvement characteristics of effective learning communities identified in this study were contradicted in both CoP theory and PLC theory. All the successful learning communities voiced their preference for decision making processes that were based on consensus. Professional learning theory contradicts this stance by suggesting there is little room for variation from existing procedures and practices within PLCs in schools. Where these PLCs do exist, it is the school administration that determines what teachers should do to support whole school improvement by providing them with organisational structures, procedural requirements, and expectations.

Existing CoP theory suggests decision-making power and influence comes to members only after an apprenticeship period during which members transition from peripheral participation to full membership; however, in a learning community there are no old hats who might lead the way for others. This is not necessarily an improvement or a good thing given much that is known about classroom teaching is tacit knowledge built up over years of teaching and stored in the minds of experienced teachers.

In the learning communities formed in this study, participants were recognised for having unique expertise in particular fields. For example, some teachers were tech savvy and became authorities for the community when technology issues needed to be addressed. Therefore, it is reasonable to suggest these community teachers had adopted a distributed cognition approach to collaborative learning, and in such a setting, the old hats, if they were recognised as such, would likely be experts in particular fields — but clearly not experts in all fields.

Other common characteristics of effective online, collaborative professional learning were identified in this study that were not identified in a search of community of practice and professional learning community literature. These characteristics were community size, visibility, leadership style, continuous improvement, pre-training, project management, and tools.
Other findings include the following:

- The minimum number of active teachers required for effective professional learning was found to be four. The community size is the number of active participants rather than the size of a community.

- Visibility is more difficult to sustain in an online setting than in a face to face setting because teachers may not be visible while still participating in online activities. Teachers are usually only (suddenly) visible when they contribute to a discussion. Teachers need to actively maintain an online presence to support the communityness of their learning community.

- The decision-making process of successful learning communities is one of consensus between all teachers. When a hierarchical approach was used by the LU group, only a few teachers contributed to the LU activities, and the rest appear to have “left them to it.”

- The pre-training required to develop teachers so they could participate in online collaborative learning was unique to individuals, and varied considerably in content and quantity from one person to the next.

- Many community teachers commented that they did not manage the timing of project activities very well. Time management, both at the individual and the whole community level was linked to capacity to learn professionally; when teachers didn’t allow time for important collaborative learning opportunities, and when project activities were compressed into a short amount of time then opportunities for professional learning were lost.

This study highlighted the need for a range of tools to support online learning community professional learning goals that were not available to teachers at the time of the study. Teachers tended to use tools they were familiar with (e.g. Facebook, SMS, WhatsApp) to supplement their use of the Moodle platform; this was a reaction to the difficulty they had trying to complete online discussions in a timely manner using Moodle forum facilities. However, these supplementary tools did not have facilities for documenting project activities or maintaining a knowledge base and, therefore, were mostly unsuitable for the tasks in which the teachers participated. All participants would have benefited from a better understanding of tool / task issues, as the tools they selected had a great influence on their resultant professional learning outcomes.

**9.2.2. Answer to Research Question Two**

*To what extent may web tracking statistics be used to locate an online, collaborative, professional learning community on a developmental trajectory?*
Teachers used digital communication tools in unexpected ways, and they used a wide range of tools, not all of which generated accessible web tracking data. Teachers made use of communication tools that they were familiar with and which (such as Facebook), on the surface, met their OLC communication needs better than the Moodle tools they were encouraged to use. However, such tools provided little or no access to conversation transcripts or web tracking data, and therefore it was difficult for teachers to look back at evidence of what they said and did during OLC conversations.

When the results of web tracking statistical analysis were compared to the results of content analysis of what teachers said, there was often a lack of convergence. For example, web tracking statistics indicated that some teachers were very active in online discussions, but on closer inspection it was found that they had high post frequencies because they had been responsible for creating initial postings for all online discussions for their OLC.

Part of the reason for the lack of convergence might lie in the fact that teachers used technologies in unexpected ways. For example, the MA teachers chose to use their discussion facility to record summaries of discussions that had been held elsewhere, and therefore web tracking statistics did not provide an indication of the excellent collaborative professional learning that had occurred before their Moodle discussion was constructed.

Given that learning communities were expected to be able to analyse their own learning performances, the researcher held out the hope that teachers might use web tracking statistics and conversation transcripts to analyse their collaborative professional learning performance. However, given that the data sets used to produce OLC web tracking statistics were incomplete it is clear that any such quantitative analysis would need to be triangulated with the results of alternate analyses.

9.3. Contribution to Scholarly Knowledge

Several substantive conclusions can be drawn from this research to contribute to a developing theorisation of online, collaborative, professional learning.

This study found it is critical for learning communities to adopt a dual-track learning strategy — one with a focus on both their students’ learning and their own capacity to
learn. While teachers need to learn about practice with a view to achieving desired student learning outcomes, more importantly, they also need to manage the development of their OLC.

In an online setting, this means much of the primary focus of teachers should be on self-regulated learning processes guided by meta-cognition. It appears teachers must, therefore, pay considerable attention to choosing and evaluating collaborative professional learning strategies, selecting technologies that support dual-track learning, and adopting operational procedures that help the community to achieve its dual-track professional learning goals.

Online, collaborative, professional learning environments are exceedingly complex and variable. The characteristics of individual learning communities vary over time, and community characteristics vary greatly from one to the next, indicating it is challenging to provide learning strategies that will be appropriate for individual learning communities operating in different settings. Therefore, learning communities need to take responsibility for their own developmental trajectory by determining where they are located on a developmental continuum and then implementing strategies to advance the professional learning capacity of their OLC.

The proposed new online, collaborative, professional learning community model (see section 9.3) was developed to represent the eight knowledge domains that inform the development and sustainment of learning communities. This model emphasizes the importance of technological knowledge, collaborative professional learning knowledge, and operational knowledge critical to the development of a learning community.

Twenty-two characteristics of effective online learning communities were identified in this study. These characteristics may be rearranged into three groups: whole community characteristics, individual teacher characteristics, and operational characteristics.

There were ten whole community characteristics:

1. *Activity levels* of a community as a whole were found to be important for community development,

2. *Significant individual contributions* from community members.
Achievable goals and purpose provide reason for teachers to want to stay connected. Intermediate goal setting was, therefore, crucial if teachers were to ever celebrate success at the end of evidence-based professional learning conversations.

Relationships of trust, respect, and challenge between the community members.

Community size — the number of actively participating members — when this number was low then the average activity level of teachers was also low and the community failed to achieve professional learning goals.

Cohesion of a community was important for promoting interaction and participation for the benefit of all community.

Visibility in discussions and other activities — when teachers were offline they were not visible; and when this was the case it had a negative effect on the rest of the community. Whether a teacher had something to say or not, it was important for them to remain active online to ensure they were seen to be a part of the community. It took considerable energy for community members to make contributions to discussions, and they may have felt their efforts were not appreciated if they did not receive a timely response to their postings.

Shared values — this made it likely the teachers were able to learn together to achieve common goals.

Intentionality of teachers provided impetus for them to complete projects. Not only was intention important, but so was the nature of that intention. Some communities appeared to be driven by the need to produce capstone project reports that represented tangible evidence of procedural compliance, while more effective learning communities tried to use their community for professional learning.

Pre-training provided teachers with the tools, practices, and procedures they needed to operationalize their online learning. Without such training some groups may have not had the wherewithal (knowledge, attitudes, skills, aspirations and behaviours) to coalesce into an effective learning community.
In addition to the group interaction characteristic, the following seven individual characteristics of effective professional learning were found:

(11) *Inquiry minded* — to be open to participation in evidence-based professional learning conversations.

(12) *Collaborative professional learning* skills, knowledge, and predispositions needed to be acquired by teachers.

(13) *ICT skills were required* so that teachers could physically communicate with others online.

(14) *Data wise teachers* were able to convince others (and themselves) of the validity of new community knowledge.

(15) *Multiliterate* participants to be able to understand what others were saying, and they were able to convey their own nuanced understandings to others using a range of different communication technologies.

(16) *Self-management* practices and tools to ensure time was set aside for learning activities, and to ensure (through reflection of learning practices) that learning was effective and efficient.

(17) *Learning load* needed to be managed at an individual level.

Five characteristics of effective learning communities were found to relate to the operational aspects of collaborative learning communities.

(18) *A consensus based leadership style* was an effective approach to decision making for the small learning communities in this study, and hierarchical management style alternatives were not.

(19) *Meta-cognitive activities* helped learning communities to evolve to a point where the community acquired the skills, knowledge and appropriately developed personal relationships to be able to sustain collective professional learning.

(20) *Project management* skills and tools helped teachers to manage project activities effectively. Time management was especially important.
(21) Online community support skills needed to be learned to ensure that the OLC was sustained. Presence and collegial support both were important to sustain a learning community.

(22) Tools adopted by a learning community either supported or inhibited online collaborative professional learning.

This new model for a learning community and the identification of factors critical to the success of such learning communities is vital new knowledge as we move forward into the age of digital connection.

9.4. Contribution to Research Methodology

This study has added to educational research methodology through the development of several new data generation and analysis instruments.

The Pre-training Learning Load Indicator rubric (table 46, section 8.32), the Collaborative Professional Learning Community Indicator rubric (table 7, section 3.5), and a radar chart called the Professional Learning Community Development Diagram were developed to use in investigating the performance of learning communities.

During the study, several research, context-specific, data generating instruments were developed. The Technological Pedagogical Content Knowledge (TPACK) questionnaire was developed during the preliminary study and used in the main study. This was found to be an effective instrument for determining the characteristics of an audience of teachers before they begin online collaborative professional learning.

The two research, context-specific, data generation instruments, or rubrics, and one radar chart were also created during the main study. These were the Pre-training Learning Load Indicator (PLLI) and the Collaborative Professional Learning Community Development Indicator (OLCDI). A radar chart called the Professional Learning Community Development Diagram was also developed for investigating the performance of learning communities.

The first rubric, the Pre-training Learning Load Indicator (PLLI), was developed as a tool to be used to identify the prerequisite skills, knowledge, and dispositions teachers had before they began online collaborative professional learning. The PLLI is a valuable new tool for establishing these pre-training needs of teachers. Applying the PLLI to the
online learning communities in this study revealed that, to one extent or another, all learning communities required some form of pre-training to enable them to be able to participate effectively in project activities. Even the most successful learning communities needed to acquire time management and organisation skills, learn how to use different tools suitable for online collaborative professional learning, and learn how to navigate through the steps of an evidence-based professional learning conversation.

The second rubric, the Collaborative Professional Learning Community Development Indicator (OLCDI), is a valuable new tool developed to determine the effectiveness of a functioning OLC, and thereby identify opportunities to advance community effectiveness. This led to the development of the Online Collaborative Professional Learning Community Development Diagram, a radar chart that can be used to track the development of a community and to identify the community development areas that will increase the capacity of the community to become more effective.

Following completion of the professional development programme in September 2011, the OLCDI was used to identify a high performing and a under-performing community. These two learning communities were selected for in-depth case study analysis. Analysis of the case studies enabled the development of the new online collaborative professional learning community model.

9.5. Implications for Policy and Practice

Several implications of the study have been identified and listed in the thesis; these include the critical need for individualized pre-training, an emphasis on dual professional learning tracks, the setting of intermediate learning goals, recognition of learning load, and iterative development of learning communities to promote collective professional learning capacity.

Twenty-two success factors were found to be crucial to the development and sustainment of learning communities. If any one of those factors was not present in a community, this was sufficient to limit the effectiveness of that community in developing collective knowledge. The findings from this study raise implications for providers of professional development, for schools, and for the Ministry of Education in Brunei Darussalam. It is possible that other providers of on-line professional development outside of the context of
Brunei Darussalam may also find value in considering these implications for policy and practice within their own contextual frameworks.

9.5.1. Implications for Professional Development Providers

Professional development providers may be expected to provide services that empower teachers to become collaborative professional learners who are self-directed and reflective about their professional development. In order to do this, professional development providers may need to address a number of professional development programme challenges. Firstly, teachers may not be familiar with monitoring their own learning performance and solving a teaching and learning problem (dual-track learning paths). Professional development providers may need to flip the order of importance of the dual learning paths. During the first several project cycles, there appears to be value for the main focus to be on building collaborative professional learning capacity. Later, once professional learning capacity is established, the focus of projects can be more directed towards developing solutions to teaching and learning problems.

This study has shown there are sometimes overwhelming challenges for teachers when learning communities are first formed, and OLC developmental trajectories are very different for different combinations of teachers. These challenges may be mitigated by ensuring individualized, achievable, dual-track, professional learning goals are developed for learning communities.

Community projects are sufficiently complex to warrant the use of project management tools, processes, and strategies, and their use should be encouraged by professional development providers. As well as being useful for guiding the completion of projects, the records produced by project management tools can provide a wealth of information that can be used by a learning community to plan future projects. There are many free online Web 2.0 project management tools teachers can use that are easy to learn, accessible, and simple to use.

**Policy:** Dual learning paths, intermediate goals, management of learning load, and multiple community developmental trajectories are features of OLC development.

Suggestions for practice include:
• Training so that professional development providers that create online environments for collaborative learning do not overload teachers and individual learning communities with more to learn than they can manage. The main focus of the first few project cycles will be the development of collaborative professional learning capacity. Teachers need to have access to tools they can use to support professional learning aspirations.

• Use rubrics and other instruments to try to establish where learning communities are on a developmental trajectory and what strategies might be appropriate for a given situation. The dual-track learning goals need to be individualized (and achievable) for each OLC.

9.5.2. Implications for Schools

A number of school level policy decisions would help to support OLC initiatives. However, since teachers belong to different schools, it is more likely an external body will support teachers in learning communities. The following policy statements indicate how schools might recognise the value of OLC initiatives and how they could support their teachers who are engaged in such activity.

Policy: Schools actively support online learning communities for professional development. For example, schools can show support for learning communities by recognising participation by teachers in such communities as being just as important as attending workshops. Schools may also showcase the work of early adopters, and provide the early pre-training opportunities necessary to get online communities jump started. Ideally, the different professional learning agendas of individual schools should not contradict or undermine the efforts of community members to reach consensus about what the professional learning goals of the community might be. The initial development of communities may require external support from learning community experts, and if so then schools should facilitate such visits.

Suggestions for practice include:

• Ensure teachers have the time, the technology, and the means to participate in online learning communities

• Alter the school’s expectations of teachers in communities to those that are achievable for teachers, and accept that it will take time and multiple project
cycles before a community has developed significant collective knowledge production capacity. The professional learning capacity of individual teachers, and groups of teachers learning together, will vary considerably, and the imposition of “one size fits all” expectations will be largely inappropriate for this type of professional development. Schools need to accept that achievement of desired student learning is a long-term goal, and that intermediate goals to do with developing the capacity of the community are equally valid.

- Schools need to understand that in this type of professional development not everything of value is measurable. Changes in disposition, levels of cohesion, and many of the other twenty characteristics associated with successful learning communities are difficult to measure, but are, nevertheless, very important to establish.

**Policy:** The “train the trainers” model of professional development does not fit well with developing online learning community capacity to learn. Trainers should be expert facilitators who guide both communities and individuals in communities along unique developmental trajectories.

Suggestions for practice include:

- Capacity to support online learning community operations will be required over an extended period of time. If expert learning community facilitators are spread too thinly across too many schools then learning community development may be less than optimal.

**9.5.3. Implications for the Ministry of Education**

The following policy and practice suggestions may help to enable the development of learning communities, and in so doing provide an effective and robust professional development option to geographically isolated teachers, who in the normal course of events have insufficient opportunities to learn with other teachers.

**Policy:** Promote dual professional learning paths and recognise that the process of building learning community capacity is more important in the beginning than the product of teaching and learning investigations.
Suggestions for practice include:

- Provide opportunities for teachers to be recognised and celebrated for the development of their learning communities. The professional learning process of teachers should be on community learning processes and not the products of teaching and learning investigations.

**Policy:** Actively support the development of learning communities in situations where alternative forms of professional development are particularly unsuitable. (There are numerous schools in Brunei that have too few teachers to be able to offer effective face-to-face collaborative professional learning.) One suggestion for practice related to this policy is:

- Manage a central office that provides a service to online learning communities in the 30 secondary and 128 primary schools in Brunei. The function of this office would be to support communities with expertise and resources. Such an office would be invaluable for teachers in the many small, isolated, rural, primary schools in Brunei.

**Policy:** The strategic goals of professional development of any kind are related to the acquisition of desired learning outcomes for students. However, as this study has shown, improvements in student learning outcomes will lag considerably behind the development of community knowledge production capacity. The creation of intermediate goals is, therefore, necessary to support teachers engaged in learning communities.

Suggestions for practice include:

- Expect teachers to make progress when they participate in OLC, but recognise progress will mean different things in different OLC contexts. Community development and individual knowledge production capacity goals are valid professional development goals during the first several projects.
- Teachers will find that they are required to adopt unfamiliar roles in their learning community, and they will need to learn experientially how to meet the demands of such roles. For example, a learning community will require a librarian to manage the community’s knowledge repository, and there will also
need for someone to project manage the progress of the community. Not everyone will need to be familiar with all roles, and therefore role capacity training will likely need to be personalised with one or two teachers requiring specialised community role training.

9.6. Suggestions for Further Research

While this research about online learning communities has significantly increased knowledge of the practice of online, collaborative, professional learning, the findings have also raised further questions for research, and some methodological questions that would benefit from further consideration.

Further research might consider the following aspects of online learning community development and practice.

1. The management of teacher learning load, especially when learning communities were developing knowledge production capacity, was revealed to be important. This raises questions about the levels and types of external scaffolding required to help learning communities as a whole and individuals in teams to develop collaborative and individual knowledge production skills.

2. Teachers learned while being immersed in a cyclical project development environment. Alternate community learning development processes have yet to be explored.

3. This study highlighted the crucial need for intermediate operational learning goals, unrelated to strategic student learning goals. These intermediate goals ensure that teachers experience success from early in the development of their community. It remains unclear exactly what these goals might be, how they might be defined, and who would be responsible for defining them in a specific online learning environment.

4. This study highlighted the tension between the need for teachers to use tools that support dual learning track investigations and the teachers’ preferences to repurpose the tools they are most familiar with. This opens the need for a line of inquiry to determine why teachers choose particular tools, and why different learning communities select and use communication tools in different ways.
5. There is the need for further research to investigate tools that will support researchers who seek to understand the development and sustainment of learning communities.

6. This study used several innovative methods to capture and process the large volumes of data that was generated by learning communities. However, more needs to be done to identify tools and methods that facilitate the capture of different kinds of data germane to an investigation of online professional learning, given that teachers will likely continue to use a range of multimodal tools in their investigations.
9.7. Concluding Statement

This study revealed that online learning communities are complex phenomena that are not well explained by current learning community theories. In particular, neither traditional Professional Learning Community theory, nor Community of Practice theory satisfactorily explain online learning communities. The study supports the need for a separate theory dedicated to explaining online learning community development for collective knowledge production.

An explanatory model for learning communities was developed to represent the eight knowledge domains that inform their development and sustainment. There were found to be twenty-two group, individual, and operational characteristics associated with effective learning communities.

The use of web statistics provided valuable information about the learning performance of learning communities, but it was also found that this source of information alone sometimes produced misleading information that was contrary to information derived from content analysis of reports and discussion transcripts. This was, in part, because teachers chose to use communication tools that were impossible to monitor, and because they chose to use tools in unexpected ways. This finding was useful in that it highlights the need to ensure teachers have the capacity to recognise the affordances and constraints of the tools they choose to use.

This study made use of Engeströms’ cultural-historical theory of activity framework diagram, which was found to be useful as an analytical lens. Activity theory diagrams were also useful for defining the questions that each learning community considers when evaluating their community learning capacity at the end of projects, as well as at different times during a project.

A number of new tools were developed during this study. The Technological Pedagogical Content Knowledge (TPACK) questionnaire was developed and found to be a useful instrument for determining the characteristics of an audience of teachers before they began online collaborative professional learning.

Protocols were developed for evidence-based professional learning conversations and for conducting investigations of the professional learning community’s learning capacity. The Collaborative Professional Learning Community Development Indicator (OLCDI) and the
Pre-training Learning Load Indicator (PLLI) were developed to determine the professional learning requirements of learning communities. The Online Collaborative Professional Learning Community Development radar diagram was used to illustrate how learning communities develop capacity to conduct collaborative professional learning over time.

MalEngTex emerged as a useful tool that enabled teachers to communicate with each other effectively. It is therefore recommended that linguistic code switching be recognised as appropriate for OLC communications.

This study has made a number of substantive contributions to an emerging theory of learning communities. Substantive contributions have also been made to an understanding of how to operationalize learning communities. A number of implications for policy and practice have been proffered as necessary to support online collaborative professional learning.

Improved learning for students depends on effective professional development; and current trends suggest that in the future online learning communities will be an increasingly important mode of professional learning. It is therefore hoped that this contribution to scholarly knowledge will contribute to understanding how to concretize online learning communities to improve student learning, both in Brunei and worldwide.
Appendix A Operational Terms and Glossary

Definitions adopted by the researcher are often not uniform, so key terms are defined in this appendix to establish positions taken in the PhD research.

AT  
Cultural-Historical Theory of Activity. A theoretical framework that may be used to gain an understanding of a human activity system such as a community engaged in a project (Engeström, 1999b).

OLCDI  
Online Learning Community Development Indicator. An instrument (rubric) that may be used to provide an indication of where opportunities for improving the professional learning capacity of a community lie. The OLCDI was developed by the author during this study.

CoP  
Community of Practice. A group of individuals who develop professional knowledge through participation in social learning activities. Communities of practice are not formal groupings. They exist as long as constituent teachers believe there is a compelling reason for belonging to such a community (Lave & Wenger, 1991; Wenger, 1998; Wenger et al., 2002).

project  
Evidence-based Professional learning conversation. A series of discussions that a community conducts for professional learning purposes. Teachers participating in a project aspire to achieve two main community goals. Firstly, they try to discover a solution to a thorny teaching and learning problem. Secondly, they evaluate and seek to improve the professional learning performance of their OLC.

ESL  
English Second Language. All the teachers in this study were ESL speakers.

ICT  
Information Communication Technology. Digital communication devices that might be repurposed for use in online, collaborative, professional learning. A non-exhaustive list of tools to be supported by technologies includes webinars, screen sharing, screen casting, online conferencing, file sharing, and collaborative online editing of documents, wiki building, website building, learning management systems, and numerous web 2.0 applications.
MalEngTex  *Malay/English/Text.* The textual language used by Brunei teachers when they communicated online. This language is a mixture of Malay language, colloquial English and the language used in social networking settings or when teachers communicate using SMS.

Moodle  *Modular Object Oriented Dynamic Learning Environment.* Moodle is a learning management system that may be used to support online learning in a social constructivist environment because it has a range of synchronous and asynchronous communication facilities including chat, online discussions, and wikis.

OLC  *Online Collaborative Professional Learning Community.* A small group of teachers that work together to complete evidence-based investigation of teaching issues as a form of professional development.

PLLI  *Pre-training Learning load Indicator.* An instrument (rubric) that provides an estimate of the learning load a community may face at the very beginning of their online, collaborative, professional learning programme. This instrument focuses on nine skills, knowledge, and predispositions.

SMS  *Short messaging service.* SMS is a mobile phone service that lets teachers send short text messages to each other in real time. Although some teachers made use of mobile service provider SMS services, many also used the free Whatsapp tool instead.

TPACK  *Technological pedagogical content knowledge.* TPACK describes the types of knowledge teachers need if they are integrating technology in their classrooms (Mishra & Koehler, 2006).

TPACKBRU  *TPACK questionnaire.* This is an online self-report questionnaire that seeks to establish teacher perceptions of their own TPACK knowledge. TPACKBRU questions are presented in Appendix E. TPACKBRU-Feb and TPACKBRU-Sep are the results of TPACKBRU being administered in February and September.

Web 2.0 tools  *Web 2.0 tools.* Online tools teachers can use to communicate and collaborate with other teachers in an online, collaborative, professional learning setting.
Appendix B Activities in a Typical Project

The following list describes the steps a typical OLC went through to complete a project.

1. A learning community began its online, evidence-based, professional learning conversation by reflecting about their own Year 7 science teaching experiences. They tried to identify a problem they believe currently exists in their own Year 7 science classrooms. The OLC then discussed the different problems identified by teachers and decided on one particular problem they would like to investigate as a team. The criteria for this selection was that everyone in the team agreed it was a worthwhile teaching and learning problem to investigate, and all agreed that they had the skills and knowledge to be able to tackle it.

2. The teacher that presented the problem that the OLC selected for investigation then proved the existence of the problem by providing digital evidence. Evidence may be in the form of test results, copies of student projects, the results of recorded classroom observations, or recordings of presentations and so on. The teacher essentially needed to provide evidence that showed the OLC that the problem truly existed.

3. Other OLC teachers requested additional information to clarify their understanding of the problem. Teachers needed to know such things as: (1) the conditions under which students produced artefacts, (2) the teacher’s role in the student learning process, and the teaching methods they used, (3) expected learning outcomes, (4) details about the physical classroom environment students worked in, and (5) the duration of instruction and any resources used.

4. Each member of the community independently assessed the evidence and suggested why there was a gap between actual and desired learning outcomes.

5. Each teacher then described why they believed there was a difference between expected and actual learning outcomes.

6. PLC teachers then discussed the range of views within their community. They sought to discover and explain differences of opinion within the community. For this most crucial step to be completed successfully, it was imperative that the teachers trusted each other enough to feel able to put forward their ideas freely and to be able to challenge the views of others.
7. Participants then engaged in a process of negotiating a single new description of the problem by co-constructing knowledge that represented a community view of how the data should be interpreted.

8. The community then worked out a pragmatic strategy they believed might be used to contribute to a solution to the problem.

9. The strategy was then tested in the classroom of one of the teachers. The OLC then evaluated the new strategy and, upon reaching agreement, updated collective OLC knowledge about the problem accordingly.

10. In the last part of a project, the community produced two summary reports. The first report was about their teaching and learning investigation. The report was formatted to include sections that matched the protocol for a teaching and learning investigation that learning communities received at the beginning of the PD programme. The second report, the OLC performance report, details the results of meta-cognitive analysis of the capacity of the OLC to achieve professional learning goals.
Appendix C project teaching and learning Investigation Protocol

Questions

Learning communities used the following questions to help them to complete a project teaching and learning investigation.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Further Explanation of the Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>What problem was investigated?</td>
<td>The community selected a teaching problem that was (1) of interest to all teachers, (2) important to solve, (3) will increase the knowledge and skills of community teachers.</td>
</tr>
<tr>
<td>What evidence supported the view that the problem really existed?</td>
<td>LC teachers needed to provide evidence of a problem. The evidence needed to be raw data rather than processed results. Typical data included scanned images of student work or digital artefacts created by students. The evidence was in digital form so it could easily be shared electronically with all community teachers.</td>
</tr>
<tr>
<td>What did the evidence say?</td>
<td>Each community member explicated their beliefs, feelings, ideas, and presuppositions by making online discussion contributions.</td>
</tr>
<tr>
<td>What differences of opinion were identified when views from step 3 were compared?</td>
<td>The community discussed the differences in interpretation of the evidence and sought to understand why these differences existed.</td>
</tr>
<tr>
<td>What was the common community view of the problem and the cause of it?</td>
<td>LC teachers negotiated a common position about what the problem is and what they believe is causing it.</td>
</tr>
<tr>
<td>What problem solutions were proposed?</td>
<td>LC participants agreed on alternative (feasible) strategies that might be implemented in a Brunei classroom setting to overcome the problem.</td>
</tr>
<tr>
<td>What does an implementation and testing plan look like?</td>
<td>An implementation and testing plan was developed. Community teachers designed a plan to implement and test one of the alternatives identified in step 6.</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>What new professional knowledge did your community teachers learn?</td>
<td>New collective professional knowledge was developed that was incorporated in the community knowledge repository</td>
</tr>
</tbody>
</table>
Appendix D Community Performance Report Questions

Learning communities needed to evaluate their own collective, professional learning performance at the end of a teaching and learning investigation. The following questions were put forward as talking points that learning communities might consider during the learning performance investigation. These questions were derived from the CHAT framework.

<table>
<thead>
<tr>
<th>Discussion topic</th>
<th>Discussion topic explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Object node</td>
<td>The object for your professional development is the motivation that your OLC had to want to work together on a project. What has your community decided might be done to ensure that your teachers might increase this motivation from one project to the next?</td>
</tr>
<tr>
<td>2. Subjects node</td>
<td>The subjects for this professional development programme are individual teachers who each have their own views, agendas, skills knowledge and experiences. What were the good and bad characteristics of your OLC? What can you do that might make your community more effective during the next professional learning conversation your group conducts?</td>
</tr>
<tr>
<td>3. Rules node</td>
<td>What rules did your community create so it could complete activities effectively? What rule changes might help to make your community even more effective? (Note that removing rules may help just as much as adding new rules!)</td>
</tr>
<tr>
<td>4. Division of labour node</td>
<td>How were tasks allocated within your professional learning community? What roles were created and used by your community? Was it enough to have a librarian and a community leader? What role changes and workload allocations do you think will help your community to perform better next time?</td>
</tr>
<tr>
<td></td>
<td>5. Tools node</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>6. Community node</td>
</tr>
<tr>
<td></td>
<td>7. Outcome node</td>
</tr>
<tr>
<td></td>
<td>8. Tension between tools &amp; object nodes</td>
</tr>
</tbody>
</table>
|   | 9. Tension between tools & subject nodes | Were the tools (chat, wiki, and forum) suitable for conducting a professional learning conversation online? Remember, the tools available need to match the resources available to teachers. If teachers do not have broadband, video conferencing might not be useful. If your community uses the social networking site called Facebook, it may find there isn’t the "digital
footprint" community teachers need to be able to refer back to in their on-going conversations.

10. Tension between tools and community nodes

Was it possible to connect with external activity systems (community) using chat, online discussions, and wikis (tools)? Were the tools available to you suitable for collaborating with teachers of other communities? How did you collaborate with people in other communities? How could this collaboration be made better through adjusting either the community or the tools to be used?

11. Tension between subject and object nodes

To what extent was the community (subject) able to complete an evidence-based professional learning project (object) effectively? Are there characteristics of your community that make completion of a conversation difficult? Perhaps some community teachers do not complete tasks on time. What can your community do to reduce the tension caused by the gap between what your group is capable of achieving and what the community is expected to do?

12. Tension between subject and division of labour nodes

How did the community (subject) decide who would be responsible for what activities (division of labour)? Were all professional learning community roles filled adequately by members of the group? Did everyone in the group contribute equally? Was enough work done to complete professional learning activities adequately?

13. Tension between subject and community nodes

Did your community make good use of external activity systems to either help your community to complete Projects? Were your community teachers able to network effectively with teachers of other communities? What could be done within your community to create a more useful network of people.
from other activity structures such as school departments, family, friends, and colleagues, and so on?

14. Tension between subject and rules nodes

What rules (rules) did the OLC create for itself, and to what extent were these accepted and followed by all teachers? How did your group establish rules, and to what extent was it possible the rules created did not suit everyone in the group? For example, there may be a rule that everyone should respond to a discussion thread at least once – however, some teachers of the group may find this difficult to do as they do not have easy access to the Internet.

15. Tension between rules and community nodes

Were any rules your community adopted consistent with the goal of fostering development of relationships with organisations like activity structures in your school, other communities, and university staff?

16. Tension between rules and object nodes

Completion of online professional learning conversations may be hindered by the rules teachers of the community have to abide by. For example, if the rules dictate people must respond to all discussion contributions, then teachers may be "procedurally compliant" whilst not actually contributing meaningfully to discussions. They may contribute information that shows a shallow level of understanding rather than the deeper understanding aspired to. To what extent, if any, did rules (rules) prevent deep, meaningful discussions during Projects (object)?

17. Tension between community and division of labour nodes

Are community teachers able to complete their project activities, or are they constrained by external activity
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>18. Tension between community and object nodes</td>
<td>systems (e.g. school and home activity structures) that limit the time they might have to contribute?</td>
</tr>
<tr>
<td>19. Tension between traditional professional development expectations and professional learning community professional development</td>
<td>Is there support for Projects from external entities such as schools, the Ministry of Education, and university research people? Does the school provide sufficient support for community teachers?</td>
</tr>
<tr>
<td>20. Tension between institutional professional development outcome expectations and professional learning community professional development outcome expectations</td>
<td>Are teachers of your community comfortable with collectively building professional knowledge, or do you feel traditional centralised workshops are more suitable for developing your professional knowledge?</td>
</tr>
<tr>
<td></td>
<td>Do you feel the 21st century skills and knowledge you learn working in your community will be valued within your school? Do you feel your efforts to improve the way you help children to learn rather than teach to examinations will be understood and valued?</td>
</tr>
</tbody>
</table>
Appendix E TPACKBRU Questionnaire

1. I have sufficient knowledge about high school science. [CK1]
   | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |

2. I am familiar with the language, notation, and procedures that are used in high school science. [CK2]
   | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |

3. I have opportunities to improve my content knowledge of year 7 science topics. [CK3]
   | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |

4. I know a range of teaching techniques that are suitable for teaching Year 7 science content. [PCK1]
   | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |

5. I can adjust my science teaching to make it more inclusive. [PCK2]
   | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |

6. I know how to develop effective lessons that match syllabus defined learning objectives. [PCK3]
   | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |

7. I know how to develop efficient lessons that will help to ensure that all topics are completed in the required time. [PCK4]
   | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |

8. I know how to assess Year 7 science students’ performances. [PK1]
   | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |

9. I can adapt my teaching based upon what my students currently understand or do not understand. [PK2]
<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td>I can adapt my teaching style to different learners. [PK3]</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>11.</td>
<td>I can assess student learning in multiple ways. [PK4]</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>12.</td>
<td>I can use a wide range of teaching approaches in a classroom setting. [PK5]</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>13.</td>
<td>I am familiar with common student understandings and misconceptions. [PK6]</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>14.</td>
<td>I know how to organise and manage classroom learning. [PK7]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>I am familiar with computer simulations and models that may help students to understand science content. [TCK1]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>I am familiar with animations I can use to help students understand concepts in the content to be learned. [TCK2]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>I am familiar with mind mapping or concept mapping software that helps students to learn about relationships between concepts and ideas. [TCK3]</td>
<td></td>
<td></td>
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</tbody>
</table>

275
18. I can find my own solutions to most technical problems when working with digital technology. [TK1]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

19. I learn new digital technologies easily. [TK2]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

20. I frequently experiment with different software. [TK3]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

21. I know about a lot of different digital technologies. [TK4]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

22. I have the technical skills to use digital technology in my teaching. [TK5]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

23. I have had sufficient opportunities to work with different digital technologies. [TK6]

<table>
<thead>
<tr>
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<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

24. I can choose a combination of pedagogy and technology to match the content I want to teach. [TPCK1]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

25. I can choose technologies that improve the quality of the content of a lesson. [TPCK2]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

26. I can create technology-enhanced lessons that are student centred. [TPCK3]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>
27. I can create lessons that allow students of different abilities to be able to learn with content that is at the right level of difficulty. [TPCK4]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

28. I can create technology-enhanced lessons that allow students to learn at their own pace. [TPCK5]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

29. I use digital technology in my lessons to ensure that students have opportunities to be active rather than passive learners. [TPCK6]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

30. I can use digital technology to create lessons that use less time than conventional lessons to achieve learning outcomes. [TPCK7]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

31. I can use technology to create rehearsal and practice classroom activities that provide computer feedback to students. [TPCK8]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

32. I know how to select effective teaching approaches to guide student thinking and learning in my subject areas(s). [TPK1]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

33. I can create opportunities for students to use digital technology for individualized learning. [TPK2]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

34. I can create opportunities for my students to participate in online discussions. [TPK3]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>
35. I can create opportunities for students to collaborate online to produce project work. [TPK4]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

36. I can create online activities that provide immediate feedback to students. [TPK5]

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree or disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

**Long answer questions section**

1. Which digital technologies do you regularly use (for any purpose) when teaching or preparing to teach in your school? [FR01]

2. What digital technologies do you use (for any purpose) outside school hours? [FR02]

3. How do you usually learn new skills and knowledge about how to use new digital equipment or new software? [FR03]

4. Describe any online collaboration activities you may have had with other science teachers (perhaps using Google Docs, a forum or Facebook to share resources). [FR04]

5. What conditions do you believe need to exist in any Brunei school if you are to make better use of technology for science teaching? [FR05]

6. What barriers exist in your school that prevent you from using technology for teaching and learning science as you would like to do? [FR06]

**Teacher information section**

1. Do you use your own laptop to make presentations in your classroom? [T105B]

2. Are you male or female? [TI01]

3. What is your date of birth? [TI03]

4. Do you own your own laptop? [TI05]

5. Do you use a computer to prepare lessons and record marks? [TI05A]

6. Do you have Internet access at home? [TI06]

7. Do you use the Internet to find lesson plans or science content you use to help prepare work for your students? [TI06A]

8. Do you use the Internet to communicate about work with other teachers? [TI06B]
9. Enter the name of your TestLed professional development group. [TI07]
10. When did you first begin work as a teacher? [TI08]
Appendix F. Comparison of Communities Using Web Tracking Statistics

The following tables provide an overview of where each community is ranked when compared to other communities. Each table has four columns. The first column (LC total) is the total frequency for a community. For example, the community called MA produced 306 wiki edits. The next column shows how the first column frequency ranks with other communities. In the case of MA, the wiki edit frequency is the highest of any community (ranked 1). The next column contains the individual median frequency for a community. The last column indicates how this median value compares to the medians of other communities. For example, the number of discussions added per MA teacher has a medium frequency of 21 and corresponding ranking of 2 when compared to all other communities.

**Table 48. MA rankings analysis**

<table>
<thead>
<tr>
<th>Activity</th>
<th>LC total</th>
<th>LC rank</th>
<th>Median</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>255</td>
<td>2</td>
<td>66</td>
<td>3</td>
</tr>
<tr>
<td>Chat view</td>
<td>24</td>
<td>9</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>111</td>
<td>5</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>Forum add post</td>
<td>428</td>
<td>1</td>
<td>112</td>
<td>1</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>1439</td>
<td>2</td>
<td>370</td>
<td>2</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>306</td>
<td>1</td>
<td>74.5</td>
<td>1</td>
</tr>
<tr>
<td>Wiki view</td>
<td>1230</td>
<td>1</td>
<td>317</td>
<td>1</td>
</tr>
<tr>
<td>Wiki view all</td>
<td>32</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

**Table 49. SA rankings analysis**

<table>
<thead>
<tr>
<th>Activity</th>
<th>LC total</th>
<th>LC rank</th>
<th>Median</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>376</td>
<td>1</td>
<td>82</td>
<td>1</td>
</tr>
<tr>
<td>Chat view</td>
<td>103</td>
<td>1</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Forum add discussion</td>
<td>86</td>
<td>7</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Forum add post</td>
<td>422</td>
<td>2</td>
<td>91</td>
<td>2</td>
</tr>
<tr>
<td>Activity</td>
<td>LC total</td>
<td>LC rank</td>
<td>Median</td>
<td>Rank</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------</td>
<td>---------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>2299</td>
<td>1</td>
<td>418</td>
<td>1</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>155</td>
<td>3</td>
<td>27</td>
<td>4</td>
</tr>
<tr>
<td>Wiki view</td>
<td>1174</td>
<td>2</td>
<td>257</td>
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<tr>
<td>Wiki view all</td>
<td>106</td>
<td>1</td>
<td>13</td>
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</table>

Table 50. LM rankings analysis

<table>
<thead>
<tr>
<th>Activity</th>
<th>LC total</th>
<th>LC rank</th>
<th>Median</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat talk</td>
<td>116</td>
<td>7</td>
<td>14</td>
<td>10</td>
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<tr>
<td>Chat view</td>
<td>50</td>
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<td>10</td>
<td>4</td>
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<tr>
<td>Forum add discussion</td>
<td>164</td>
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<tr>
<td>Forum add post</td>
<td>367</td>
<td>3</td>
<td>83</td>
<td>3</td>
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<tr>
<td>Forum view discussion</td>
<td>1354</td>
<td>3</td>
<td>311</td>
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<tr>
<td>Wiki edit</td>
<td>127</td>
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<td>33</td>
<td>3</td>
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<tr>
<td>Wiki view</td>
<td>619</td>
<td>5</td>
<td>140</td>
<td>4</td>
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<tr>
<td>Wiki view all</td>
<td>26</td>
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Table 51. JE rankings analysis

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<th>Rank</th>
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<tr>
<td>Chat talk</td>
<td>116</td>
<td>7</td>
<td>19</td>
<td>9</td>
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<tr>
<td>Chat view</td>
<td>34</td>
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<tr>
<td>Forum add discussion</td>
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<td>4</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Forum add post</td>
<td>321</td>
<td>4</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>Forum view discussion</td>
<td>1224</td>
<td>4</td>
<td>159.5</td>
<td>9</td>
</tr>
<tr>
<td>Wiki edit</td>
<td>4</td>
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<td>0.5</td>
<td>9</td>
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<tr>
<td>Wiki view</td>
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<td>10</td>
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<td>10</td>
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<tr>
<td>Wiki view all</td>
<td>8</td>
<td>10</td>
<td>1</td>
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### Table 52. LU rankings analysis

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<th>Median</th>
<th>Rank</th>
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</thead>
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<td>9</td>
<td>20.5</td>
<td>8</td>
</tr>
<tr>
<td>Chat view</td>
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<td>7</td>
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<tr>
<td>Forum add post</td>
<td>284</td>
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<td>31</td>
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### Table 53. TT rankings analysis

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<th>Median</th>
<th>Rank</th>
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</thead>
<tbody>
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<td>29</td>
<td>6</td>
</tr>
<tr>
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Appendix G. Moodle Activities Recorded in Moodle Server Logs

1. **Assignment upload** – upload a project report or community performance report. These reports are project capstone artefacts.
2. **Assignment view** – review instructions for uploading project capstone reports
3. **Assignment view all** – review instructions, especially final dates, for uploading project capstone reports
4. **Blog view** – view an individual’s blog
5. **Chat talk** – make a contribution to a private online synchronous discussion with other community teachers
6. **Course enrol** – enrol in the course associated with this research
7. **Course user report** – a statistical report of activity (for example, view-activity frequency) within a course
8. **Course view** – view of the course content associated with the professional development course.
9. **Forum add discussion** – add a new private discussion that community teachers will participate in while completing a project.
10. **Forum add post** – add a posting to an online discussion during a project
11. **Forum view discussion** – view the transcript of an individual project discussion
12. **Forum view forum** – view the discussion topics in a particular PLC
13. **Forum view forums** – View the name of all sets of discussions created on the Moodle system
14. **Quiz attempt** – not used in this professional development programme
15. **Quiz close attempt** – not used in this professional development programme
16. **Quiz review** – not used in this professional development programme
17. **Quiz view** – not used in this professional development programme
18. **Quiz view all** – not used in this professional development programme
19. **Resource view** – view the list of downloadable resources available in this programme
20. **Upload** – To upload a resource to the list of uploads available to students
21. **User update** – update a teacher profile
22. **User view** – view a teacher profile
23. **User view all** – view the list of teachers enrolled in the professional development programme
24. **Wiki edit** – Alter a wiki page
25. **Wiki view** – view a wiki
26. **Wiki view all** – view the names of all wikis
Appendix H. Factors that Impact on Learning Performance

The following paragraphs list the main characteristics that impact on the capacity of a learning community to produce knowledge and be able to sustain itself.

Learning Community Teacher Characteristics

1. The number of active teachers in a community is four or greater.
2. Learning Community teachers contribute to project activities with similar levels of activity.
3. Learning Community teachers are friends.
4. Learning Community teachers have established relationships of trust and challenge.
5. Learning Community teachers are equals and do not want a leader who delegates work to others.
6. Learning Community teachers value fairness and expect all teachers to contribute equally.
7. Learning Community teachers monitor the progress of their community and the work of others to verify fairness and as a project management function.
8. Learning Community teachers actively support each other and their community.
9. All community teachers have access to the same social networking tool.
10. Learning Community teachers believe that work commitments must be prioritized ahead of professional development.
11. Learning Community teachers are familiar with digital technology and can repurpose new tools for collaborative professional learning.
12. Learning Community teachers are individualistic and competitive, but can change.
13. Learning Community teachers make a point of setting aside time for professional development.
14. Learning Community teachers are accustomed to passive learning in professional development workshops but can change.
15. Learning Community teachers support distributed cognitive responsibility.
Procedures and Processes

16. Teachers can apply project management skills and knowledge.
17. Teachers go beyond procedural compliance when applying the project completion guidelines towards use of the project as a vehicle that supports professional learning.
18. Teachers have adopted consensus based decision making (horizontal management).
19. Teachers have well-developed ways of communicating effectively with each other (teacher talk).
20. Teachers use multiple modes of communication to overcome the limitations of Moodle and limited Internet access.
21. Teachers make use of a range of tools and choose tools that are accessible to all teachers in the OLC, and that meet the required need at the time.
22. Teachers make use of mobile devices such as mobile phones and tablets.
23. Teachers continually refine the processes and procedures of their OLC.
24. Teachers understand that the language of discussion is different to the language of publication.
25. Teachers have a method for recording project activities for later review and analysis.

Learning Load

26. Teachers are required to learn new software tools.
27. Teacher must learn the project completion guidelines.
28. Teachers are required to develop project management skills.
29. Teachers learn a process for building professional knowledge collectively with other community teachers.
30. Teachers learn research skills and knowledge.
Appendix I. Moodle Activity Level Statistics

This Appendix presents Moodle activity level statistics for each of the communities concerned with this study. Note the use of the following acronyms.

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Table 62. Moodle activity level statistics for LU

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291
### Table 63. Moodle activity level statistics for TT

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A project begins a professional learning conversation by justifying the choice of topic to investigate. It is good to remember what the student learning outcomes are that we are looking for. We should also consider looking at problems that are feasible for us to look at. Some things we cannot change - look at things that we can change. Look at things that are NEW to the group teachers - then everyone has a chance to develop their knowledge and skills.

Let's do rubric! Yes?

Sure sure...

ok.. i agree.. because now, with BCAT for year 7.. rubric is everywhere.. student not yet familiar with RUBRIC.

So what's our main focus on rubrics?

Perhaps on how to use the rubrics.

main focus nya on how to make them understand the basic idea of rubrics.. how to assess their assessment without bias etc

just pick a simple topic saja.....

Simple topic like...?

Can we decide on a simple topic in the syllabus and then we teach them in using rubric to achieve the learning outcomes?

There hasn't been any replies made so i was wondering if we could get this report done and over with...

I heard from another group that they are doing on a specific topic to discuss on for example "Density". So can we just discuss on a specific topic and answer the other following questions to get this report done? Tq...

Sorry people. Has been so busy with the BCAT thing sampai inda temasuk here.

Yeah.. i agree with Li Keh. Let get this report done once and for all. Ok.. last time it was agreed that we do rubric. And it was also agreed that we just used the present BCAT. Right? Correct me i'm wrong. We're waiting Zul to email us the guideline regarding our project. Maybe i'll text him tomorrow for reminder.

Yes, rubric plg....so we just discuss abt the topic on density or measuring volume like that? So wich do we concentrate majorly in which we want to help student to understand the concept much better? We have to be precise la....just to concentrate on one small topic like that sal ada report ok udh tu....we do something like what Mr Maroney ever showed before in class.

I really cnt go online after tomoro anymore coz we not b in Brunei till 25th

We do topic on density.

Lets do macam fajar dulu yg pressure. Remember?

So in the rubric we make simple ja. Can just put the definition, formula and units. We take 3 questions ka saja. Tadi i message c Zul sudah. Hope he can send it asap.

Payah eh like this. I prefer we all discuss face to face. Tantu..

Ok. Mana sja th...asal ada
So we are going to investigate about:
"Will teaching be effective in using rubrics in learning the topic density?"
What do you think? If ok, we can go to the next questions =)

TESTLED
'Investigating A Science Teaching And Learning Problem'
Duration given - One Month

Wah so longgg ah...
Bah i haven't marked my PA 1 yet can u believe that? Hehe.. I may not be able to do the investigation at scl cause Im gonna b on leave starting 28th March - 7th April. When is the exact date to submit this report?

Zul, i like ur idea...
If we are to carry it out again, that will not be possible as we might be doing BCAT 2 in the next term. Unless we entirely used the evidence from BCAT 1 only then we don't have much to worry abt.Our sch haven't conduct BCAT 1 yet as we all planned after this sch holidays. So i wudnt b able to share my students results, so sorry. Deadline is before we go for Session 5 (before 13th April) with Mr Maroney.

Do we need to upload the evidence? Or we just discuss abt it here?

Kami baru ada discussion on how to mark them lapas buka sekolah.

Hani, inda papa tu. Di fahami =) Kekeke..

U guys, rubric okay..but using bcats dari cdd maybe not quite gud idea...bg ku lah..if we can come up with a new rubric for the proposed topic that is density?mav?salnya ah,aku mbuat udah, the thing is aku sendiri paneng dengan rubric bsdia buat ah...its not properly organized..problem is do we have time g???

Am i in the rite track??hehe.

bah, aku dengan senang hati dpt meng outline few problems rubric bcats ne. I will bring the bcats sample tomoro n aku gto ah apa yg realy ancur. nda pyh student, aku sndiri pun nda pham... we can design simple rubric skajap saja if tani berada kepala..haha..p a2 lah ah,cukup kh nda masa kan jdi kan student tani 'guinea pig' or mouse lab??hehe..ketglan syllabus g dah..ahhh...paneng ku..byk commitment eh..mcm ku sorang sjaa yg strezz....

Ahaha..batik g udh buat BCAT. Me havent....after sch reopens mcm2 sja kaja kena bgi buat. (暖心~)~~ Bh sok tani discus brabris. Apa rasa kamukn sal TESTLED ani??Ada kena mengena arh tani ka?Mcm buang masa sjaa :p

alhamdulilah... at last te dapat tah ku wireless connection yg working properly.. terima kasih kpada kursus kita ani.. hehehe.. k. update ja k.. i'll try to contribute as much as i can.. and online everyday)))
rachel, u jadi pakai yg mana? mind mapping o questions from ziqah?

I think i juz stick to my mind mapping because i dont have much tym to prepare coz i got lots of slacking wrk at sch already
Wot do u all think?

mo worries.. fine w me.. jangantah buat yang payah2.. continue ja dengan apa yang ada.. ))) k, c ya soon
Yeah ok with me too. Lagi pun we are running out of time sudah. Better just finish this ASAP. Short, simple and straight to the point. Plus i hope my wireless ne inda damam. So i can keep track. Hehe..
Appendix K. Education in Brunei

Brunei is a small Islamic Sultanate (area 5,765 sq. km) on the northwest coast of Borneo, bordered by Sarawak, Sabah, and the South China Sea. It has an estimated population of 401,890, of which 66.3 percent are Malay, 11.2 percent Chinese, 3.4 percent indigenous peoples, and 19.1 percent unclassified. Most Bruneians are Muslim (67%) followed by Buddhists (13%), Christians (10 %), and then others (10 %) (Central Intelligence Agency, 2009).

Brunei has small state status (Bray, 2011), and this presents the country with a number of challenges not found in larger states. Some challenges include limited human resource capacity at all levels of education, and the practice of adopting educational policies from larger states that do not successfully scale to smaller states. Small states are often reliant on single industries for the bulk of their gross domestic product, and to this end, Brunei is dependent on the country’s oil and gas industry.

In 2010, Brunei reported having a total of 30 state secondary schools employing 3142 teachers to educate 34,308 students. The average number of teachers per school was 105, and the average size of a state secondary school was 1144 (Brunei Education Data Management Section, 2010). There was a gender imbalance in higher education in Brunei in 2008, as shown in Table 68. The imbalance in higher education goes some way to explaining the gender imbalance amongst teachers in Brunei schools, given higher education is a prerequisite for joining the teaching service.

<table>
<thead>
<tr>
<th>Year</th>
<th>Level</th>
<th>No. Students</th>
<th>Percentage of males</th>
<th>Percentage of females</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>High school</td>
<td>6161</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>8</td>
<td>High school</td>
<td>6363</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>9</td>
<td>High school</td>
<td>7786</td>
<td>54%</td>
<td>46%</td>
</tr>
<tr>
<td>10</td>
<td>High school</td>
<td>6150</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>11</td>
<td>High school</td>
<td>7328</td>
<td>49%</td>
<td>51%</td>
</tr>
<tr>
<td>12</td>
<td>Upper Secondary</td>
<td>2711</td>
<td>42%</td>
<td>58%</td>
</tr>
<tr>
<td>13</td>
<td>Upper Secondary</td>
<td>2401</td>
<td>41%</td>
<td>59%</td>
</tr>
<tr>
<td>14</td>
<td>Tertiary Level Education</td>
<td>2013</td>
<td>37%</td>
<td>63%</td>
</tr>
<tr>
<td>15</td>
<td>Tertiary Level Education</td>
<td>1468</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>16</td>
<td>Tertiary Level Education</td>
<td>1583</td>
<td>36%</td>
<td>64%</td>
</tr>
<tr>
<td>17</td>
<td>Tertiary Level Education</td>
<td>757</td>
<td>32%</td>
<td>68%</td>
</tr>
</tbody>
</table>
There was a teacher gender imbalance in secondary schools with females 2141 (68%) outnumbering males 1001 (32%) by a factor of more than 2:1. The greater proportion of female teachers in schools may be, in part, because fewer boys than girls have gone on to complete a tertiary education.

This may reflect the fact that, in Brunei, males are often encouraged to start bringing in money to support their extended family as soon as they are able to work, rather than waiting until they have gained a higher education qualification.

Students in secondary schools are prepared for Cambridge Institute of Education ‘O’ and ‘A’ level examinations. Despite efforts to change classroom practices, many students, parents, and teachers remain wedded to tried and true traditional pedagogies they believe best prepare students for Cambridge ‘O’ level and ‘A’ level examinations.

If the professional development of teachers is to be supported by

**Availability of Technology to Brunei Teachers**

It is necessary that teachers in an online learning community need access to an appropriate technology platform that they know how to use if they are to be able to build collective knowledge successfully. In essence, teachers required easy access to sufficient equipment of the right type, appropriate individualized training about how to use technologies effectively, sufficient technical support when they needed it, sufficient time to learn to use new digital tools, and appropriate institutional support for the required time and space needed for community learning (Hew & Brush, 2006; Salmon, 2005; Wright, 2010).

In the recent past, Brunei school teachers found school technology platforms to be insufficient for reliable communication with anyone (Moroney, Norilah, Brown, & Loo, 2009). Wireless Internet access was often either limited or non-existent, and cable access was also classed as unreliable. However, since 2009, there has been a rapid rise in the use of mobile phones that can be used to connect to the Internet. Teachers (in 2011) were just as likely to tether their mobile phone rather than rely on an institution’s bandwidth.

Brunei teachers are familiar with, and regularly use, a range of online communication tools (e.g. Facebook, e-mail, MSN messenger), productivity tools (e.g. Google search engines, Google documents), and online resource sites (e.g. Wikipedia, 4teachers.org,
Teachers in Brunei engaged in social networking, as evidenced by a recent newspaper report that revealed that Brunei leads Asia in Facebook usage with penetration at 59.25 percent (Hayat, 2012).

However, social networking dialogue is not the same as focused collaborative professional learning, and technologically literate teachers may have little idea of how to use online tools to collectively develop new professional knowledge (Wright, 2010). Wright suggests, for example, that there remains the need to ensure teachers have the necessary multiliteracies required to participate online:

*Multiliteracies* is a term coined by the New London Group in order to describe what constitutes literacy in the 21st century. The term acknowledges the idea of textual multiplicity. This idea encompasses the technological explosion of what constitutes a text, and considers this in relation to cultural and linguistic diversity and what it means to be literate (Wright, 2010, p. iii)

In addition to textual multiplicity, Wright suggests that developing multiliteracies means learning how to understand “aspects of texts such as agency, motivation, gaps and silences, and political and economic agendas” (Wright, 2010, p. 5). Wright signalled the importance of cultural literacy, something important in this study where teachers who are all of either Malay, Chinese, or Indian ethnicity. Each ethnic grouping has its own culture, values, religion and language and preferences for interacting. Each ethnic group is sensitive about particular topics and it is important that teachers know what these sensitivities are if they are to avoid causing offense. For example, there are cultural norms for communicating a difference of opinion that need to be understood if harmony is to be maintained between teachers in a multicultural learning community.

Beyond the capacity to communicate, teachers need an organisational structure that helps them to learn together as a team. The next section discusses how communities of teachers in Brunei organise themselves to achieve community goals and how the management strategies they adopt influence their capacity to conduct collaborative professional learning.

**Vertical Management Structures**

Education in Brunei is closely managed (centrally) by a vertical (hierarchical) management structure called the Ministry of Education (UNESCO International Bureau of Education, 2010). Brunei teachers adopt teaching methods suggested to them by a
higher authority rather than creating a course of action themselves. Teachers are usually supplied with a scheme of work that goes into considerable detail about exactly what resources are to be used to teach a specific topic. In some ways this limits teacher’s options for creative and innovative teaching. The schemes of work teacher’s use are very full, which further limits pedagogical variation to those methods that quickly get through content.

**High Stakes Testing**

Schools use the performance of students in external examinations as an indicator of institutional wellbeing. However, although assessment of, and for, learning is important, heavy reliance on written examinations at the end of a unit of work may not be reliable or valid indicators of learning performances (Smith & Fey, 2000).

Brunei, in 2011, had not yet adopted subject level standards, and schools relied on summative assessment in the form of written examinations rather than on other more robust and reliable forms of assessment. It follows then that teachers and school administrators in Brunei did not have the assessment data they needed to make very well informed decisions about the extent of student learning. Because of a paucity of data for on-going assessment of student performance, it also follows that teachers (and schools) were likely unfamiliar with inquiry-based investigations of the learning performances of their students (Moroney, Aminatol Norlilah Hj Abdullah, Brown, & Loo, 2008).

**Teacher Performance Appraisals**

One of the environmental factors that teachers continuously consider is annual job appraisal reporting. Performance appraisals of Brunei teachers are conducted annually; the results are of great concern to individual teachers because reviews may be used by school administrators to decide whether teacher contracts are renewed, make promotion decisions, and determine eligibility for annual bonuses. Student performances in high stakes examinations are factored into teacher appraisals; therefore, teachers are inclined to adopt pedagogical practices that are likely to maximise examination results; they do teach to the exam. Given the culture in schools, teachers may feel more comfortable (safer) being told what to do by a head of department (risk transference) than being creative or innovative in their classroom. Under these conditions, teachers may not wish to commit fully to collaborative professional learning unless it is simply to share existing practices rather than try to solve long-standing practice problems.
This section has highlighted some of the possible reasons why, in the Brunei setting, teachers may be unfamiliar with collaborative professional learning, why they may not be especially interested in participating in it, and why they prefer to be told what to do rather than decide for themselves. The next section describes the typical workload of secondary school teachers, and thereby illuminates the quality and quantity of time teachers have available for professional development.

**Teacher Workload**

Classes in Brunei schools are often conducted in separate afternoon and morning sessions. Senior secondary school classes (Years 9 to 12) are taught between 7.30 a.m. and 12.30 p.m.; junior classes (Years 7 and 8) are taught in the afternoons (12.45 p.m. until 5.30 p.m.). Usually, teachers are allocated to either the morning or afternoon session, but not both. Outside of regular teaching hours, teachers are required to conduct extra classes for several afternoons per week. Extra classes are typically used for revision or reinforcement of what was (or was not) learned in morning classes. However, at times, extra classes are used to teach new content. This is especially so in the sciences where there are insufficient science laboratories and equipment available for the number of enrolled students. Apart from the possibility of being required to work quite long weekdays, teachers also find they are occasionally required to conduct extra classes or to attend to other official school matters during their weekends.

Teachers in Brunei also have duties other than classroom teaching. For example, a teacher may be also be responsible for such things as timetabling, discipline, school records management, student attendance, academic records, and so on. Unlike in other countries, many of these activities are supported by manual systems that could be automated, and thereby unnecessarily require teachers to spend many hours completing administrative tasks (Moroney et al., 2008). Participation in these activities is extraordinarily and unnecessarily time-consuming for teachers, and deprives them of time that might be more usefully spent engaging in professional learning (Moroney, Norilah, et al., 2009).
Appendix L: Development of the Online Learning Community Development Indicator

This short appendix describes the development of the online learning community development indicator (OLCDI). The items in the OLCDI were derived from the research literature about communities of practice and online collaborative learning that has been presented summarised in sections 2.1, 2.2 and in Chapter 1.

The OLCDI was further refined iteratively and cyclically as the data collected in the study was analysed. When the findings of the study could not be mapped onto an item in the OLCDI, or when findings contradicted what was reported in the literature review, then the OLCDI was updated to reflect this. An initial OLCDI was developed directly from the literature review. This was modified during the analysis of the ten communities before being further refined after analysis of the two case studies.

Table 69. Online learning community development indicator (OLCDI)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>High performing community</th>
<th>Underperforming community</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Activity level</td>
<td>The community collectively demonstrates high levels of interaction by generating a high number of discussion posts and by engagement in a high number of other knowledge production activities.</td>
<td>Low levels of collective participation in knowledge production or community building activities</td>
</tr>
<tr>
<td>2 Outliers</td>
<td>Interquartile range for posting frequency distributions is small – indicating all teachers contributed equally, and no outliers. Outliers are teachers that dominate knowledge production activities. Their presence is indicated by high levels of activity in knowledge building activities.</td>
<td>Large posting frequency interquartile range and/or presence of outliers.</td>
</tr>
<tr>
<td>3 Goal orientation</td>
<td>The community has collectively defined the learning goals it hopes to achieve.</td>
<td>Little or no evidence that learning was a driver for completing professional development activities. An alternative driver may</td>
</tr>
<tr>
<td>4 Relationships</td>
<td>Relationships of trust, respect, and challenge; effective disagreement resolution strategies</td>
<td>Relationships remain under developed, and/or the community has become divided</td>
</tr>
<tr>
<td>5 Community Size</td>
<td>Four or more active community members</td>
<td>Three or fewer active community members</td>
</tr>
<tr>
<td>6 Community support</td>
<td>Community members actively support the sustainment and continuing development of their community</td>
<td>Little or no evidence of community building activities</td>
</tr>
<tr>
<td>7 Visibility</td>
<td>Community members are highly visible online, as indicated by web tracking</td>
<td>Teachers are by and large infrequent contributors to online activities</td>
</tr>
<tr>
<td></td>
<td>Values</td>
<td>Teachers have shared values that support OLC goals</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Intentionality</td>
<td>Focused conversations that addressed project protocol questions</td>
</tr>
<tr>
<td></td>
<td>Pre-training</td>
<td>All community members have prerequisite skills knowledge and dispositions required to participate in projects.</td>
</tr>
<tr>
<td>Teacher Characteristics</td>
<td>Inquiry minded</td>
<td>Individuals are active in CPL project investigations that seek to solve teaching and learning problems</td>
</tr>
<tr>
<td></td>
<td>Collaborative learning skills</td>
<td>Individuals participate meaningfully in learning community activities</td>
</tr>
<tr>
<td></td>
<td>ICT</td>
<td>Individuals have access to, and the means to use ICTs for knowledge production</td>
</tr>
<tr>
<td></td>
<td>Data wise</td>
<td>Individuals have the skills and knowledge to collect, process, and present data effectively</td>
</tr>
<tr>
<td></td>
<td>Learning Load</td>
<td>Individuals have germane cognitive load capacity available for online collaboration, in part because they had little in the way of pre-training required to prepare for participation in knowledge production activities</td>
</tr>
<tr>
<td></td>
<td>Self-Management</td>
<td>Individuals manage their own time properly so they are able to make timely contributions to community activities</td>
</tr>
<tr>
<td></td>
<td>Multiliteracies</td>
<td>Sends, receives, and understands messages in a range of modalities; knows the features and constraints of different online communication tools</td>
</tr>
</tbody>
</table>

**Online Learning Community Operational Characteristics**

<p>|   | Leadership style              | Consensus decision making, though possibly some organizing roles allocated to individuals as well | Hierarchical leadership style and some delegation of roles |
|   | Continuous improvement        | OLC teachers adjusted procedures and protocols to enhance CPL performances | OLC teachers failed to consider ways to improve their CPL performances |
|   | Project management            | Managed time, activity scheduling, and assigning members to cooperative and collaborative activities as appropriate. Collected evidence of performance to inform future community design | No evidence of the use of project management strategies |</p>
<table>
<thead>
<tr>
<th></th>
<th>Protocol/process mastery</th>
<th>The community successfully used project guidelines for knowledge production and community development</th>
<th>Teachers failed to follow project guidelines and focused on procedural compliance and artefact output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tools</td>
<td>Teachers selected tools that helped them to produce knowledge reliably, efficiently and effectively</td>
<td>Teachers used tools they were familiar with rather than the supplied knowledge building tools, or they used the supplied tools ineffectively</td>
</tr>
</tbody>
</table>
References


Fullan, M. (2006). Leading professional learning: Think 'system' and not 'individual school' if the goal is to fundamentally change the culture of schools. The School Administrator, 10(63).


