TEACHER COMPETENCY IN CHINESE
INDEPENDENT HIGH SCHOOLS IN PENANG

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by

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# TABLE OF CONTENTS

ACKNOWLEDGEMENT...........................................................................................................ii

TABLE OF CONTENTS............................................................................................................iii

LIST OF TABLES....................................................................................................................xv

LIST OF FIGURES...................................................................................................................xvi

LIST OF ABBREVIATIONS.....................................................................................................xvii

ABSTRAK................................................................................................................................xix

ABSTRACT...........................................................................................................................xx

# CHAPTER 1 - INTRODUCTION

1.1 Introduction ......................................................................................................................1

1.2 Background of the study ...............................................................................................6
   1.2.1 Scenario of Chinese Independent High Schools ......................................................6
   1.2.2 Current situation of in-service training of Chinese Independent High Schools ......................................................7

1.3 Statement of Problem ....................................................................................................9

1.4 Aims and Objectives of the Study ...............................................................................14

1.5 Significance of the Study .............................................................................................16

1.6 Limitations of the Study ...............................................................................................17

1.7 Operational Definition .................................................................................................18

1.8 Conceptual Framework .................................................................................................22

1.9 Conclusion .....................................................................................................................33
CHAPTER 2 - LITERATURE REVIEW

2.1 Introduction ...........................................................35
2.2 History of Chinese Independent High Schools in Malaysia ..........35
2.3 Characteristics of Chinese Independent High Schools in Malaysia ...38
2.4 History of CIHS Model in Administering Teachers’ Competency ...40
2.5 Theories related to mathematics teachers competencies ................41
2.6 In-service Training Programmes of CIHs and Teachers’ Competencies ......45
  2.6.1 Design of Systematic Training Programmes of CIHs and ..........46
      Teachers’ Competencies
  2.6.2 Formation of a Three-Step Training Model .....................50
2.7 The Importance of Teacher Competency ...............................52
2.8 Literature Reviews on Mathematics Teachers’ Competencies Research 53
2.9 Literature Reviews on the Teacher Competency Standard ..............60
2.10 Literature Reviews on the Teacher Education Training ................62
2.11 Teacher Competence in Educational Assessment ......................65
  2.11.1 Teachers should be skilled in choosing assessment methods .......66
         appropriate for instructional decisions
  2.11.2 Teachers should be skilled in developing assessment methods ....67
         for instructional decisions
  2.11.3 Teachers should be skilled in administering, scoring and interpreting
         the results of both externally-produced and teacher-produced
         assessment methods .................................................67
  2.11.4 Teachers should be skilled in using assessment results when making
         decisions about individual students, planning teaching, developing
         curriculum, and school improvement ................................68
  2.11.5 Teachers should be skilled in developing valid student grading ....68
         procedures which use student assessments
2.11.6 Teachers should be skilled in communicating assessment results to students, parents, other lay audiences, and other educators……..69

2.11.7 Teachers should be skilled in recognizing unethical, illegal, and otherwise inappropriate assessment methods and uses of assessment information……………………………………………………………..70

2.12 Theory of Teacher Competency as the Core of Knowledge…………………70

2.13 Professional Competence of Teachers as a Multidimensional Construct…..73

2.14 Conclusion………………………………………………………………………………………………75

CHAPTER 3 - RESEARCH METHODOLOGY

3.1 Introduction………………………………………………………………………………………………77

3.2 Research Design………………………………………………………………………………………77

3.3 Location of the Study…………………………………………………………………………………81

3.4 Population and Sampling……………………………………………………………………………84

3.5 Instrumentation………………………………………………………………………………………88

3.6 Pilot Study……………………………………………………………………………………………92

3.6.1 Validity……………………………………………………………………………………………92

3.6.2 Reliability…………………………………………………………………………………………94

3.7 Data Collection Procedures…………………………………………………………………………96

3.8 Data Analysis…………………………………………………………………………………………98

3.9 Ethical Considerations……………………………………………………………………………103

3.10 Conclusion…………………………………………………………………………………………103
CHAPTER 4 RESEARCH FINDINGS

4.1 Introduction.................................................................................................................105

4.2 Profiles of the Respondents.........................................................................................106
   4.2.1 School principals.................................................................................................106
   4.2.2 Senior assistant..................................................................................................109
   4.2.3 Mathematics department head................................................................. 111
   4.2.4 Mathematics teachers......................................................................................114
   4.2.5 Senior education students................................................................. 116

4.3 Mathematics in CIHSs..............................................................................................117

4.4 Thematic Analysis on the Five Areas of Mathematics
   Teachers’ Competence..............................................................................................120

4.5 Content Knowledge of Mathematics Teachers......................................................122
   4.5.1 Criteria of recruitment......................................................................................123
      4.5.1(a) Principals’ perspective.................................................................................123
      4.5.1(b) Mathematics department heads’ perspective............................................126
      4.5.1(c) Mathematics teachers’ perspective.........................................................127
   4.5.2 High standard of UEC......................................................................................127
      4.5.2(a) Principals’ perspective.................................................................................127
      4.5.2(b) Senior assistants’ perspective.................................................................129
      4.5.2(c) Mathematics department heads’ perspective............................................130
      4.5.2(d) Mathematics teachers’ perspective.........................................................131
   4.5.3 Classroom observation......................................................................................133
      4.5.3(a) Principals’ perspective.................................................................................133
      4.5.3(b) Senior assistants’ perspective.................................................................134
4.5.3(c) Mathematics department heads’ perspective..................135

4.5.4 Insufficiency in CK of new mathematics teachers..................136
  4.5.4(a) Principals’ perspective........................................136
  4.5.4(b) Senior assistants’ perspective................................137
  4.5.4(c) Mathematics department heads’ perspective..................138
  4.5.4(d) Mathematics teachers’ perspective..........................139

4.5.5 Lesson plans preparation...........................................140
  4.5.5(a) Principals’ perspective........................................140
  4.5.5(b) Senior assistants’ perspective...............................141
  4.5.5(c) Mathematics department heads’ perspective..............143
  4.5.5(d) Mathematics teachers’ perspective........................144

4.5.6 Various methods of CK assessment................................145
  4.5.6(a) Principals’ perspective......................................145

4.5.7 Students’ perspective on CK of their mathematics teachers.....146
  4.5.7(a) School A......................................................146
  4.5.7(b) School B......................................................148
  4.5.7(c) School C......................................................149
  4.5.7(d) School D......................................................149
  4.5.7(e) School E......................................................150

4.5.8 Summary of the findings of mathematics teachers’ CK.........151

4.6 Pedagogical Content Knowledge of Mathematics Teachers........153
  4.6.1 The importance of pedagogical content knowledge.............154
    4.6.1(a) Principals’ perspective..................................154
4.6.1(b) Senior assistants’ perspective………………………………156
4.6.1(c) Mathematics department heads’ perspective………………156
4.6.1(d) Mathematics teachers’ perspective…………………………158

4.6.2 Training is important to improve teachers’ competencies……159
4.6.2(a) Principals’ perspective……………………………………159
4.6.2(b) Senior assistants’ perspective……………………………161
4.6.2(c) Mathematics department heads’ perspective…………….162
4.6.2(d) Mathematics teachers’ perspective……………………….163

4.6.3 Classroom observation to verify PCK…………………………163
4.6.3(a) Principals’ perspective……………………………………163
4.6.3(b) Senior assistants’ perspective…………………………….165
4.6.3(c) Mathematics department heads’ perspective…………….165
4.6.3(d) Mathematics teachers’ perspective……………………….166

4.6.4 PCK of teachers and their specialization……………………167
4.6.4(a) Principals’ perspective……………………………………167
4.6.4(b) Mathematics department heads’ perspective…………….167
4.6.4(c) Mathematics teachers’ perspective……………………….168

4.6.5 Diagnostic skills of teachers toward weak students…………169
4.6.5(a) Principals’ perspective……………………………………169
4.6.5(b) Senior assistants’ perspective…………………………….170
4.6.5(c) Mathematics department heads’ perspective…………….172
4.6.5(d) Mathematics teachers’ perspective……………………….175

4.6.6 Competency in using teaching aids…………………………178
4.6.6(a) Principals’ perspective ................................. 178
4.6.6(b) Senior assistants’ perspective ........................... 179
4.6.6(c) Mathematics department heads’ perspective ........... 180
4.6.6(d) Mathematics teachers’ perspective ...................... 181

4.6.7 Classroom management competency ........................ 182
4.6.7(a) Principals’ perspective ................................. 182
4.6.7(b) Senior assistants’ perspective ........................... 183
4.6.7(c) Mathematics department heads’ perspective ........... 183
4.6.7(d) Mathematics teachers’ perspective ...................... 184

4.6.8 Assessment of students’ performance competency ........... 185
4.6.8(a) Principals’ perspective ................................. 185
4.6.8(b) Senior assistants’ perspective ........................... 187
4.6.8(c) Mathematics department heads’ perspective ........... 188
4.6.8(d) Mathematics teachers’ perspective ...................... 192

4.6.9 Students’ perspective on PCK of their mathematics teachers .... 195
4.6.9(a) School A ................................................. 196
4.6.9(b) School B ................................................. 197
4.6.9(c) School C ................................................. 199
4.6.9(d) School D ................................................. 203
4.6.9(e) School E ................................................. 205

4.6.10 Summary of the findings of mathematics teachers’ PCK ............. 207

4.7 Pedagogical/psychological Knowledge of Mathematics Teachers ........ 209
4.7.1 Understanding of students’ learning behavior .................... 210
4.7.1(a) Principals’ perspective .................................. 210
4.7.1(b) Senior assistants’ perspective ................................................. 212
4.7.1(c) Mathematics department heads’ perspective .......................... 213
4.7.1(d) Mathematics teachers’ perspective ........................................ 214

4.7.2 Understanding of students’ learning process ............................... 216
4.7.2(a) Principals’ perspective ......................................................... 216
4.7.2(b) Senior assistants’ perspective .............................................. 217
4.7.2(c) Mathematics department heads’ perspective .......................... 219
4.7.2(d) Mathematics teachers’ perspective ........................................ 222

4.7.3 Understanding of individual student characteristics ...................... 224
4.7.3(a) Principals’ perspective ......................................................... 224
4.7.3(b) Senior assistants’ perspective .............................................. 225
4.7.3(c) Mathematics department heads’ perspective .......................... 225
4.7.3(d) Mathematics teachers’ perspective ........................................ 226

4.7.4 Students’ perspective on PPK of their mathematics teachers ........ 228
4.7.4(a) School A ............................................................................. 228
4.7.4(b) School B ............................................................................. 229
4.7.4(c) School C ............................................................................. 231
4.7.4(d) School E ............................................................................. 232

4.7.5 Summary of the findings of mathematics teachers’ PPK ................. 233

4.8 Organizational Knowledge of Mathematics Teachers ....................... 234

4.8.1 The gap between Dong Zong and CIHSs .................................... 236
4.8.1(a) Principals’ perspective ......................................................... 236
4.8.1(b) Senior assistants’ perspective .............................................. 237
4.8.1(c) Mathematics department heads’ perspective ................. 239
4.8.1(d) Mathematics teachers’ perspective ............................ 240

4.8.2 Knowledge of the organization and ecology of the school ........ 242
4.8.2(a) Principals’ perspective ........................................... 242
4.8.2(b) Senior assistants’ perspective ................................... 243
4.8.2(c) Mathematics department heads’ perspective .................. 244
4.8.2(d) Mathematics teachers’ perspective ............................. 245

4.8.3 Knowledge of the school quality and effectiveness ............. 246
4.8.3(a) Principals’ perspective ........................................... 246
4.8.3(b) Senior assistants’ perspective ................................... 248
4.8.3(c) Mathematics department heads’ perspective .................. 249
4.8.3(d) Mathematics teachers’ perspective ............................. 250

4.8.4 Knowledge of the management, governance and transparency .... 251
4.8.4(a) Senior assistants’ perspective ................................... 251
4.8.4(b) Mathematics department heads’ perspective .................. 251
4.8.4(c) Mathematics teachers’ perspective ............................. 252

4.8.5 Students’ perspective on organizational knowledge of their mathematics teachers .............................................. 253
4.8.5(a) School A ............................................................. 253
4.8.5(b) School B ............................................................. 254
4.8.5(c) School C ............................................................. 254
4.8.5(d) School D ............................................................. 256
4.8.5(e) School E ............................................................. 256

4.8.6 Summary of the findings of mathematics teachers’ organizational knowledge .................................................. 256
4.9 Counseling Knowledge of Mathematics Teachers.................................258

4.9.1 Competencies in dealing with students’ educational career..................259

4.9.1(a) Principals’ perspective.............................................................259

4.9.1(b) Senior assistants’ perspective..................................................261

4.9.1(c) Mathematics department heads’ perspective..............................262

4.9.1(d) Mathematics teachers’ perspective.........................................264

4.9.2 Competencies in dealing with students’ learning difficulties..............266

4.9.2(a) Principals’ perspective.............................................................266

4.9.2(b) Senior assistants’ perspective..................................................267

4.9.2(c) Mathematics department heads’ perspective..............................268

4.9.2(d) Mathematics teachers’ perspective.........................................269

4.9.3 Competencies in dealing with students’ behavioral problems...........270

4.9.3(a) Principals’ perspective.............................................................270

4.9.3(b) Senior assistants’ perspective..................................................272

4.9.3(c) Mathematics department heads’ perspective..............................273

4.9.3(d) Mathematics teachers’ perspective.........................................274

4.9.4 Competencies in consulting skills..................................................275

4.9.4(a) Principals’ perspective.............................................................275

4.9.4(b) Senior assistants’ perspective..................................................276

4.9.4(c) Mathematics department heads’ perspective..............................278

4.9.4(d) Mathematics teachers’ perspective.........................................278

4.9.5 Students’ perspective on counseling knowledge of their mathematics teachers..................................................279

4.9.5(a) School A..................................................................................279
CHAPTER 5 DISCUSSION AND CONCLUSION

5.1 Introduction.................................................................301

5.2 Summary of Findings......................................................301

5.2.1 Content knowledge of mathematics teachers.........................302

5.2.2 Pedagogical content knowledge of mathematics teachers...........305

5.2.3 Pedagogical/psychological knowledge of mathematics teachers.....308

5.2.4 Organizational knowledge of mathematics teachers..................309

5.2.5 Counseling knowledge of mathematics teachers......................311

5.3 Discussion........................................................................314
5.4 Implications........................................................................................................324

5.5 Recommendations................................................................................................327

5.5.1 Recommendations based on the research findings........................................327

5.5.2 Recommendations for future research.............................................................328

5.6 Conclusion............................................................................................................329

REFERENCES......................................................................................................331

APPENDICES
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table 1.1</th>
<th>Mathematics result in UEC-SML of CIHS in Penang state compared to National level</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2.1</td>
<td>Thematic Focus of In-service Training Programmes for CIHS Teachers</td>
<td>48</td>
</tr>
<tr>
<td>Table 2.2</td>
<td>Master Programme in the Area of School Administration</td>
<td>49</td>
</tr>
<tr>
<td>Table 3.1</td>
<td>Location of CIHSs in Malaysia</td>
<td>85</td>
</tr>
<tr>
<td>Table 3.2</td>
<td>Distribution of Informants</td>
<td>88</td>
</tr>
<tr>
<td>Table 3.3</td>
<td>Amendments made on the Instruments</td>
<td>93</td>
</tr>
<tr>
<td>Table 3.4</td>
<td>Research Matrix</td>
<td>104</td>
</tr>
<tr>
<td>Table 4.1</td>
<td>Tabular representation of the stages undertaken in this study</td>
<td>121</td>
</tr>
<tr>
<td>Table 4.2</td>
<td>Participants’ view about what constitutes CK</td>
<td>123</td>
</tr>
<tr>
<td>Table 4.3</td>
<td>Participants’ view about what constitutes PCK</td>
<td>154</td>
</tr>
<tr>
<td>Table 4.4</td>
<td>Participants’ view about what constitutes PPK</td>
<td>210</td>
</tr>
<tr>
<td>Table 4.5</td>
<td>Participants’ view about what constitutes organizational knowledge</td>
<td>235</td>
</tr>
<tr>
<td>Table 4.6</td>
<td>Participants’ view about what constitutes counseling knowledge</td>
<td>259</td>
</tr>
<tr>
<td>Table 4.7</td>
<td>Summary of the Result</td>
<td>293</td>
</tr>
</tbody>
</table>
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.1</td>
<td>Research Framework</td>
<td>22</td>
</tr>
<tr>
<td>Figure 1.2</td>
<td>The COACTIV Model of Professional Competence</td>
<td>32</td>
</tr>
<tr>
<td>Figure 2.1</td>
<td>Mathematics teachers' professional competencies</td>
<td>44</td>
</tr>
<tr>
<td>Figure 3.1</td>
<td>Data collection procedure</td>
<td>97</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>AST</td>
<td>Academy for Singapore Teachers</td>
<td></td>
</tr>
<tr>
<td>CIHS</td>
<td>Chinese Independent High School</td>
<td></td>
</tr>
<tr>
<td>CK</td>
<td>Content Knowledge</td>
<td></td>
</tr>
<tr>
<td>COACTIV</td>
<td>Cognitive Activation in the Mathematics Classroom &amp; Professional Competence</td>
<td></td>
</tr>
<tr>
<td>DH</td>
<td>Mathematics Department Heads</td>
<td></td>
</tr>
<tr>
<td>GCSE</td>
<td>General Certificate of Secondary Education</td>
<td></td>
</tr>
<tr>
<td>IEA</td>
<td>Evaluation of Educational Achievement</td>
<td></td>
</tr>
<tr>
<td>IGCSE</td>
<td>International General Certificate of Secondary Education</td>
<td></td>
</tr>
<tr>
<td>MTCS</td>
<td>Mathematics Teachers’ Competencies Scale</td>
<td></td>
</tr>
<tr>
<td>MTS</td>
<td>Malaysian Teacher Standards</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Principal</td>
<td></td>
</tr>
<tr>
<td>PCK</td>
<td>Pedagogical Content Knowledge</td>
<td></td>
</tr>
<tr>
<td>PPK</td>
<td>Pedagogical/Psychological Knowledge</td>
<td></td>
</tr>
<tr>
<td>PT3</td>
<td>Pentaksiran Tingkatan 3</td>
<td></td>
</tr>
<tr>
<td>SA</td>
<td>Senior Assistant</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Senior Secondary Education Student</td>
<td></td>
</tr>
<tr>
<td>SEAR-MT</td>
<td>Southeast Asia Regional Standards for Mathematics Teachers</td>
<td></td>
</tr>
<tr>
<td>SJKC</td>
<td>National-type Chinese Primary School</td>
<td></td>
</tr>
<tr>
<td>SPM</td>
<td>Sijil Pelajaran Malaysia</td>
<td></td>
</tr>
<tr>
<td>STPM</td>
<td>Sijil Tinggi Persekolahan Malaysia</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>Teacher</td>
<td></td>
</tr>
<tr>
<td>TEDS-M</td>
<td>Teacher Education and Development Study in Mathematics</td>
<td></td>
</tr>
<tr>
<td>UCSCAM</td>
<td>United Chinese School Committees Association of Malaysia</td>
<td></td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------</td>
<td></td>
</tr>
<tr>
<td>UEC</td>
<td>United Examination Certificate</td>
<td></td>
</tr>
<tr>
<td>UEC-JML/JUEC</td>
<td>UEC Junior Middle Level</td>
<td></td>
</tr>
<tr>
<td>UEC-SML/SUEC</td>
<td>UEC Senior Middle Level</td>
<td></td>
</tr>
<tr>
<td>UEC-V</td>
<td>Vocational Unified Examination</td>
<td></td>
</tr>
</tbody>
</table>
KOMPETENSI GURU SEKOLAH MENENGAH PERSENDIRIAN CINA DI PULAU PINANG

ABSTRAK

Kajian ini bertujuan untuk meneroka tahap kompetensi guru matematik di Sekolah Menengah Persendirian Cina (CIHS) di negeri Pulau Pinang. COACTIV model yang merangkumi pengetahuan kandungan (CK), pengetahuan kandungan pedagogi (PCK), pengetahuan pedagogi:psikologi, pengetahuan penyelarasan, dan pengetahuan kaunseling digunakan sebagai kerangka konsep. Seramai 55 orang responden terlibat temu bual mendalam dan temu bual berfokus dengan menggunakan teknik persampelan berperingkat. Terdapat lima kumpulan responden iaitu lima orang pengetua, lima orang penolong kanan, lima orang ketua bidang matematik, 13 orang guru matematik, dan 27 orang pelajar dari lima buah CIHS. Pengetua, penolong kanan, dan ketua bidang matematik terlibat dalam temu bual mendalam sementara guru matematik dan pelajar terlibat dalam temu bual berfokus. Dapatan kajian menunjukkan CK, PCK, dan PPK adalah penting untuk guru matematik manakala pengetahuan penyelarasan dan pengetahuan kaunseling agak kurang diberi keutamaan. Dapatan kajian menunjukkan kelima-lima kompetensi didapati bukan sahaja bersesuaian secara konsep dengan COACTIV model bahkan dapat memantapkan teori yang digunakan. Akhir sekali, kajian ini berjaya menyumbang pengurusan dan pembangunan sumber manusia di CIHS secara khusus dan bidang pendidikan secara amnya.
TEACHER COMPETENCY IN CHINESE INDEPENDENT HIGH SCHOOLS IN PENANG

ABSTRACT

This study aimed to explore the competencies of mathematics teachers in Chinese Independent High Schools (CIHSs) of Penang state. The COACTIV model that including content knowledge (CK), pedagogical content knowledge (PCK), pedagogical/psychological knowledge (PPK), organizational knowledge, and counseling knowledge was used as conceptual framework. A total of 55 participants were selected to involve in in-depth and focus group interviews using multi-stage sampling technique. There were five groups of participants, namely five principals, five senior assistants, five mathematics department heads, 13 mathematics teachers, and 27 students of the five CIHSs. Principals, senior assistant, and mathematics department heads were involved in in-depth interviews while mathematics teachers and students were involved in focus group interviews. Results revealed that CK, PCK, and PPK are generally recognized as important to be possessed by mathematics teachers in CIHSs. However, the organizational knowledge and counseling knowledge seemed to be neglected. Findings revealed that all the five competencies, namely CK, PCK, PPK, organizational knowledge, and counseling knowledge not only fits conceptually into COACTIV model but also reinforced the theories used in this study. Finally, this study has successfully contributed to human resource management and development particularly in CIHSs and also in the field of education generally.
CHAPTER 1

INTRODUCTION

1.1 Introduction

Teacher competence is denoted as a set of professional skills and dispositions that teacher should possess in order to carry out his or her job effectively (Hospesová & Tichá, 2017). Hence competence is declared in construction with the professionalization of the teacher’s knowledge and defining ‘mathematics’ and ‘teaching’ as critical factors of mathematics teacher’s actions in the classroom activity (Scherer & Steinbring, 2003). Studies on professional competencies of mathematics teachers have expanded significant relevance in the last decades especially due to criticism about the incompetence of teacher education for a sufficient development of teachers’ professionalism (Kaiser et al., 2017). Kaiser et al.’s study showed the sophisticated nature of mathematics teachers’ expertise, the complex interplay between its different knowledge-based and situated competence facets, and the high relevance of teaching practice for teachers’ development in order to become true experts in their field.
Chinese Independent High Schools (CIHSs) is a type of private high school in Malaysia. They provide secondary education in the Chinese language as the prolongation of the primary education in Chinese national-type primary schools. The medium of instruction in these schools is Mandarin with simplified Chinese characters writing. Currently, there is 60 CIHSs in the nation, including 23 from East Malaysia, and they represent a small number of the high schools in Malaysia. Malaysia is unique in all of Southeast Asia in possessing a vibrant network of Chinese schools that are a part of the national education system. In fact, it is the strengths of this nation that Malaysia is the only country with a parallel educational system incorporating to national, vernacular, and private schools including Chinese Independent High Schools (Wong, 2015).

An important amount of recent research in the field of mathematics education revolves around what high quality mathematics teaching needs (Moreira & David, 2008), and what mathematics knowledge for teaching is (Ball, 2003). Meanwhile, these demands are also concluded in mathematics teacher standards in Malaysia. Mathematics teachers, at least in the past, were highly respected within the Chinese community and as ‘custodians of Chinese education’. They are the most important element of the education system due to their education and qualification can therefore play a decisive role in optimizing educational processes (Cochran-Smith & Zeichner, 2005; Darling-Hammond & Bransford, 2005; Kennedy, Ahn & Choi, 2008). They need to possess a body of knowledge and be able to apply that knowledge to a variety of situations within their
This body of knowledge involves knowledge of subject matter and pedagogy, including pedagogical content knowledge (Shulman, 1987), as well as a philosophical, historical, and sociological framework for educational ideas (Cowen, 2002).

Past researchers (Alnoor, Guo, Abduhaim, 2015; González, 2014; Hospesová & Tichá, 2017; Kaiser et al., 2017; Marbán, 2009; Niss, 2016) highlighted that mathematics teacher competence is recognized as an important requisite to improve students' academic performance and their experiences of schooling. According to Pauline Goh (2011), the current strategy in Malaysia to improve this competency and outcomes of education culminated in the delivery of the *Standard Guru Malaysia* or the Malaysian Teacher Standards introduced in December 2009. Empirical educational research has investigated various aspects of the teaching profession from different theoretical perspectives with the aim of identifying effective means of improving teacher recruitment and training (Baumert & Kunter, 2013).

In the literature, different elements of mathematics teacher competence have been emphasized throughout the history of evaluating teachers. As preparing and implementing instruction can be seen as the key challenge of the teaching profession (Woolfolk Hoy, Davis & Pape, 2006), the success of teaching practice can be measured in terms of their ability to initiate and support learning processes that enable students to achieve specific pedagogical objectives. If creating effective teaching and learning situations in the
classroom and enabling students to achieve their learning objectives are regarded as the key tasks of any teacher, it follows that research attention should focus on those mathematics teacher characteristics that are necessary conditions for achieving these outcomes (Baumert & Kunter, 2013).

In sum, researcher utilized Baumert and Kunter’s (2013) Cognitive Activation in the Mathematics Classroom and Professional Competence (COACTIV) Model of teachers’ professional competence that encompasses content knowledge, pedagogical content knowledge, pedagogical/psychological knowledge, organizational knowledge, and counselling knowledge. The theoretical objective of the COACTIV model is to identify the qualities that mathematics teachers need in order to meet the demands of their profession, with the focus of interest being on classroom instruction. The aim in COACTIV was to integrate these approaches within an overarching model combining findings from various research perspectives to test the teaching competencies of mathematics teachers in CIHSs.

Given the fact that the nature of good mathematics teaching is not assumed in one certain context, particularly mathematics teachers’ beliefs about what constitutes good mathematics teaching, there have been increasing research interests focusing on investigating good mathematics teaching in various contexts, especially those in East Asia, such as South Korea, Singapore, Hong Kong, and Mainland China, where students demonstrated outstanding performance in international comparative studies (Yang, 2012). Therefore, quality in education requires scientific management with a clear concept of
development and above all with high quality mathematics teachers able to transform education from "the bottom up" (Blaško & Raschman, 2015). The quality of CIHSs is most closely connected with the quality of their teachers. It can be concluded that problems related to the quality of education are associated primarily with ensuring working conditions for mathematics teachers as well as their competencies.

Recent concern for the quality of education in CIHSs has placed pressure on school administrators to assess and upgrade the professional competency of teaching staff as emphasized by Wong (2015). This is in accordance with the statement made by Barber, Barber, Whelan and Clark (2010) as well as Day, Sammons, Hopkins, Harris, Leithwood, Gu and Brown (2010). Barber et al. and Day et al. stated that there is a growing body of evidence that school management and leadership has the greatest impact on teachers in the classroom and is the key success factor to achieve a school's organizational goals. Nevertheless, school administrators can increase the likelihood of attracting and retaining competent and devoted professional in their classroom by combining clinical supervision, teacher evaluation, in-service teaching training and professional learning communities (Ellis, 1984). Since teacher professional competence is the most important factor in relation to student achievement (Barber et al., 2010), the extent to which school administrators are successful in driving mathematics teachers' professional competencies based on COACTIV model is another vital measure of the school management success.
1.2 Background of the Study

To conduct a study, background of a study that illustrates the environment and setting of the study need to explore. The background of this study focuses on two aspects; the scenario of CIHSs and current situation of in-service teacher training of CIHSs.

1.2.1 Scenario of Chinese Independent High Schools

The United Chinese School Committees Association of Malaysia (UCSCAM, the association of Chinese school teachers and trustees) also known as the Dong Jiao Zong, coordinates the curriculum used in the schools and organizes the Unified Examination Certificate (UEC) standardised test. Despite this, the schools are independent of each other and are free to manage their own affairs. In short, these CIHSs operate as ‘independent’ entities (Wong, 2015).

Some of these CIHSs also participate in the government secondary school examination offered under the national education system. The UEC as mentioned above is previously not recognized by the government but is accepted as a qualification for direct admission to an increasing number of foreign universities in countries such as Australia, Britain, Canada, China/Hong Kong/Taiwan, New Zealand, Singapore, and the United States of America. Chinese high school graduates have been worthy of their credentials and have performed well in foreign universities (Wong, 2015).
Malaysia is the only country outside Mainland China, Hong Kong/Macao, and Taiwan with an ‘integrated’ system of Chinese education from primary to tertiary levels. Currently, the 60 CIHSs distributed in some of the larger towns of Malaysia boast an enrolment of around 60,000 students (Dong Zong Examination Bureau, 2012: 411). This number represents a substantial increase over the total of more than 41,000 in 1980 (Lee, 2011: 179). In the past four decades, more than half a million students have graduated from these schools. A recent trend is the admission of an increasing number of Malay and Indian students in CIHSs. This is perhaps a reflection of the quality and resilience of the Chinese education system that has been able to stand the test of time (Wong, 2015).

1.2.2 Current situation of in-service teacher training of Chinese Independent High Schools

The earliest training of Chinese school teachers took place in Kuala Lumpur in July 1924 with an intention to supply locally-trained teachers to the Chinese schools in Malaya (AR on Education in FMS for the Year 1924, in Supplement to FMS, 1925: 18, quoted by A.B. Tan, 2015: 190). There are two nationwide organizations were inaugurated in the early 1950s, one organizing the teachers and the other the board of directors of Chinese schools. The former was the United Chinese Teachers’ Association (Jiao Zong) established in 1951 while the other was Dong Zong established in 1954. The latter’s daily administration is spread over eight bureaux, including one charged with the responsibility of managing the work of teacher training of CIHS.
According to the record of Dong Zong Schools and Teachers Bureau (2013), the number of current teaching staff in CIHS exceeds 3,900, consisted of a multi-ethnic team of Chinese, Malay and Indian teachers who account for 87.9, 5.1 and 5.9 per cent of the total respectively. The Education Affairs and Teaching Personnel divisions of Dong Zong are assigned to implement and manage teacher training programme in order to improve teachers' competencies in their teaching profession.

The key roles of these divisions cover the following aspects as follow: (i) Provide training to novice teachers so that they possess the basic professional teaching skills; (ii) Provide subject training to in-service teachers to improve their teaching skills through the competent use of teaching materials and methods; (iii) Provide professional training for form teachers to raise the professional competence and performance of form/class teachers through short-term and intensive training courses; (iv) Provide management training for senior administrative staff for the purpose of upgrading administrative skills and to nurture a core of future administrators. This management training generally is a short-term training programmes in co-operation with relevant organizations in China or Taiwan (Wong, 2015).
1.3 Statement of Problem

A successful effort to change school is only possible if the teacher becomes its leading agent (Hospesová and Tichá, 2017). Hospesová and Tichá (2003) pointed out that the basis of the mathematics teacher’s knowledge and professional competence which encompass pedagogical competence, subject didactic competence, pedagogical-organizational competence, and competence in a qualified pedagogical (self-) reflection are the demands to mathematics teachers to lead a change to the school. This corresponds to researcher’s notion about the complex nature of mathematics teacher’s profession and researcher would like to take it as a basis of his considerations concerning mathematics teachers’ professional competencies in CIHSs.

Mathematics is a subject that helps the students to describe ideas and relationships drawn from their environment. The importance of mathematics has been recognized by societies for ages (Alboor et al., 2016). As the science of patterns, mathematics enables the students to make the invisible visible and thereby solve the problems that would otherwise be impossible. On this line of reason, mathematics teachers become the key to improving mathematics education (Alboor et al., 2016). Understanding mathematics teachers’ professional competencies will enable students to engage in their learning process which assist them to form interest, creativity, application, discovering, and gathering ideas in mathematics (Maat & Zakaria, 2010). This is because mathematics teachers must possess their professional competencies which require them to outline their teaching materials and plan daily lesson effectively (Idris, 2006). It is anticipated that
mathematics teachers’ professional competence should be a major factor influencing the students’ achievement (Koon, 2005).

In recent year, curriculum programs that support the visions of the reform for school mathematics in CIHSs have been developed by Dong Zong. Because of the UEC-SML is recognized as the entrance qualification in many tertiary educational institutions internationally such as Singapore, Australia, Taiwan, China, and some European countries as well as most private colleges in Malaysia, the standards-based curricula was designed at a very high international standard (Dong Zong Examination Bureau, 2012). As a consequence, mathematics teachers in CIHSs are required to possess the ability to understand, judge, do and use mathematics in a variety of intra- and extra-mathematical contexts and situations in their instructions in order to prepare their students to cope with the high standard of UEC-SML.

The current teaching staff strength in CIHS exceeds 3,900 in numbers (Wong, 2015) and is likely to increase in future. A key performance index by which a teacher's prospects for advancement are assessed is the success rates of students and the brilliance of their examination scores. Teachers in CIHSs particularly are required to spend large amounts of time and energy to help students to excel in examinations such as UEC and Sijil Pelajaran Malaysia (SPM). However, the Senior Middle (UEC-SML) result analysis at national level (Dong Jiao Zong UEC report, 2015) showed that mathematics subject had the highest percentage of failure from the academic year 2012 to 2015, ranged from 19.15 to 24.96 per cent. In year 2012, 2013, 2014 and 2015, UEC failure percentage was 19.79%
over 4411 candidates, 24.96% over 4831 candidates, 19.15% over 4861 candidates and 20.63% over 5302 candidates respectively. It can conclude that mathematics subject was the lowest performance among all the 20 subjects in UEC-SML examination.

If this UEC-SML result is considered to be the benchmark at national level, mathematics result of UEC-SML in CIHSs in Penang was lower than the indicated benchmark (refer to Table 1.1). Table 1.1 shows that CIHSs in Penang performed below the national level in terms of excellent and good results which were 9.7 percent and 18.44 percent while national level were 18.1 percent and 31.97 percent for Grade A and Grade B respectively. Majority of Penang CIHSs candidates obtained Grade D in their mathematics subject of UEC-SML results.

Table 1.1: Mathematics result in UEC-SML of CIHS in Penang state compared to National level

<table>
<thead>
<tr>
<th>Grade (%)</th>
<th>A (%)</th>
<th>B (%)</th>
<th>C (%)</th>
<th>D (%)</th>
<th>E (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIHS Penang</td>
<td>9.7</td>
<td>18.44</td>
<td>23.3</td>
<td>39.8</td>
<td>8.73</td>
</tr>
<tr>
<td>National level</td>
<td>18.1</td>
<td>31.97</td>
<td>22.25</td>
<td>19.62</td>
<td>8.06</td>
</tr>
</tbody>
</table>

Source: Dong Zong UEC-SML examination analysis report, 2015

The above results showed that mathematics teachers in CIHSs particularly in Penang state is urgency to study in order to identify their professional competencies so that this will constantly innovate the current situations. According to European Commission (2012), this includes having critical, evidence-based attitudes, enabling them to respond to students’ outcomes, new evidence from inside and outside the classroom, and professional dialogue, in order to adapt to their own practices.
Across the world, community expectations for mathematics teacher professional competence appear to be rising at the same time as the status of mathematics teachers is declining (Moon, 2007). This seems to be the case for mathematics teachers in Malaysia as well. The literature on teaching and understanding teacher professional competence continues to expand. Changes continue to be made for better clarity towards the concept of effective or successful dimensions of teacher professional competence (Kaiser et al., 2017; Pauline Goh, 2011). However, regardless of how tedious it is to encompass the concept of teacher professional competence, educational stakeholder particularly in CIHSs need credible measures to judge professional competence, teaching performance or to help guide mathematics teacher professional development and training.

Razo’s findings (2014) indicated that there was a statistically difference existed in student achievement (percentages of passing) between teacher awarded performance pay to teachers not awarded performance pay. Owing to CIHSs are not entitled to receive fixed government funding therefore the maintenance of the schools is mainly dependent on donations from the Chinese community. In short, it is very challenging financial constraints for board of directors in CIHSs to retain high professionally competent and quality teachers without focus on increasing their salaries based on their abilities. Razo’s study revealed that the effects of teacher performance pay on the following results: make a positive impact on student achievement, attract and retain quality teachers, promote cohesiveness and a cooperative spirit within the school community, and promote individual strengths and allow for individual differences. Teachers’ salaries and students’ expenses in CIHSs solely rely on non-governmental organization to provide relevant. On
top of that, CIHS teachers have to fulfil the higher demands from parents and society compared to national schools.

Despite the relatively long history of Chinese education in Malaysia, it is beset with numerous problems and constraints that pose serious challenges to the Chinese community. Operating in a multi-ethnic setting in which Malay is the official language and English is the second language Chinese education occupies a marginal position that is kept alive by sustained financial and moral support of the Chinese community. Operating under testing circumstances, these schools are confronted by problems of funding, shortage of qualified teachers, and contention with official policies, among others (Wong, 2015).

A real issue confronting CIHSs is the shortage of qualified teachers because CIHSs are in the absence of access to official teacher training. Over time, the need for qualified teachers in CIHSs has become crucial and the pressure for a constant supply of such teacher is escalating. In 2007, Dong Zong and the CIHS management through its National Working Committee launched a package of training programs to meet the long-term needs of competent and qualified teachers of the CIHS (Wong, 2015).

This study of CIHSs in Malaysia is chosen due to their viability for more than 60 years of operation without government aids. The school in general is still way below the demand or fulfillment of the society. Furthermore, the shortage of well-trained teachers for the jobs, with high turn-over rate of teachers hampers the teaching industry. At the moment, training provided to teacher pre or in-service are not appropriate or adequate as
there are limited past research findings for references. In addition, lack of administrative skills of the school board of directors and lack of guidelines that caused a study has to be addressed to solve the problem. One of the most widely recognized measures that influence student achievement and success in schools is teacher professional competence (Maat & Zakaria, 2010). For this reason, this research will report on an investigation which gave ‘voice’ to a rather ignored segment of the Malaysian education community.

To my knowledge, there is limited studies that directly measured professional competencies encompassing five major components namely CK, PCK, PPK, organizational knowledge, and counseling knowledge possessed by mathematics teachers in Penang CIHSs being investigated. The COACTIV model was used because it could measure the implications of the five components of professional competence for processes of learning and instruction in secondary level mathematics (Baumert et al., 2010).

1.4 Aims and Objectives of the Study

It is reasonable to conjecture that mathematics teacher competencies could be different in different areas. Therefore, investigating principals, senior assistants, mathematics department heads, mathematics teachers, and students’ views of what constitutes mathematics teachers’ competencies in various areas will not only help to establish a deeper and more comprehensive understanding of mathematics teachers’ competencies in their teaching but also uncover cultural influences of teaching practice. Basically the proposed study is to look at the teaching competencies of mathematics
teachers focusing in the circumstance of the case study of CIHSs in Penang. The following are the key aims of this research:

I. To explore what constitutes mathematics teachers’ competencies in the areas of content knowledge (CK) from the perspectives of five school principals, five senior assistants, five mathematics department heads, 13 mathematics teachers, and 27 students.

II. To explore what constitutes mathematics teachers’ competencies in the areas of pedagogical content knowledge (PCK) from the perspectives of five school principals, five senior assistants, five mathematics department heads, 13 mathematics teachers, and 27 students.

III. To explore what constitutes mathematics teachers’ competencies in the areas of pedagogical/psychological knowledge (PPK) from the perspectives of five school principals, five senior assistants, five mathematics department heads, 13 mathematics teachers, and 27 students.

IV. To explore what constitutes mathematics teachers’ competencies in the areas of organizational knowledge, from the perspectives of five school principals, five senior assistants, five mathematics department heads, 13 mathematics teachers, and 27 students.

V. To explore what constitutes mathematics teachers’ competencies in the areas of counselling knowledge from the perspectives of five school principals, five senior
assistants, five mathematics department heads, 13 mathematics teachers, and 27 students.

1.5 **Significance of the Study**

This research seeks to add to the understanding of mathematics teachers’ competence through an investigation of the conceptions of competence held by mathematics teachers from various perspectives in CIHSs. Although there are some studies that related to the conceptions of competency of teachers, for example, Cheng and Cheung (2004) and Huntly (2003), there is very limited studies (if at all) that looks specifically at the teaching competencies of CIHSs in Malaysia. At least, Malaysian CIHS community will finally have their voices heard in relation to the conception of their mathematics teachers’ teaching competencies. Hopefully it will make useful contribution to the on-going conversation among educators and policy makers about teacher competency.

Teacher is the heart and soul of classroom instruction (Fullan, 2000; Hargreaves, 2004); they are in fact lifelong learners. The effectiveness of the teacher depends on her competence (academically and pedagogically) and efficiency (ability, work load and commitment), teaching and learning resources and methods; support from school administrators (Rogan, 2004; Van den Akker & Thijs, 2002; Mosha, 2004). Results of this study enable to provide a learning platform for mathematics teachers where they are
aware of how to improve their competencies in handling challenges in the classroom in particular and school generally.

1.6 Limitations of the Study

There are 60 CIHS in Malaysia which are scattered unevenly throughout Malaysia. Therefore researcher has to employ multi-stage sampling which covers geographical cluster sampling followed by purposive sampling so that it will be practical and greater economy to get sufficient samples. By using this sampling technique, the study will limit to only one state which has the most CIHSs from one of the randomly selected cluster. The rationale of this limitation is the accessibility and sufficiency of source required. Although Malaysia has many type of schools such as National School, National Chinese type and private school and international school but this study is just limited to CIHS. The main reason is that these schools currently do not have a proper and comprehensive teacher training programme. CIHS administrative team is facing a numerous problems due to the fact that quality teachers are needed to improve education standard. Although there are many factors affecting the quality of mathematics teachers but this study is just focused on teaching competencies.

Researcher utilizes COACTIV (Cognitive Activation in the Classroom: Professional Competence of Teachers, Cognitive Activating Instruction, and Development of Students Mathematical Literacy) model by Baumert and Kunter (2013) to investigate teaching competencies of mathematics teachers in CIHS. The guiding idea of this model was to develop a generic model of teachers’ professional competence that
could then be specified for mathematics teachers. One this line of reasoning, the target group is limited to mathematics teachers only.

1.7 Operational Definition

Teaching competence is a description of one’s ability, a measure of one’s performance. A teacher’s competencies can be defined in terms of one’s knowledge, skills, and behaviours. The task of a mathematics teacher is closely tied to the nature of the classroom. Today’s classroom requires teachers to prepare virtually all students for higher order thinking and performance skills once reserved to only a few (Darling-Hammond, 2006: 300). Researchers and practitioners are becoming increasingly aware that the character of the 21st century classroom and thus the demands on both students and teachers is undergoing significant change.

Researcher utilizes the COACTIV model which had been specified for the context of mathematics teaching (Brunner et al., 2006; Krauss et al., 2006). This model has been distinguish teachers’ competencies into four aspects of competence namely knowledge, beliefs, motivation and self-regulation. This study is focused on one of the four aspects of competence that is professional knowledge. The professional knowledge is determined by five components of knowledge namely CK PCK, PPK, organizational knowledge, and counselling knowledge. Each of which comprises more specific components derived from available research literature.

CK is characterised as a thorough understanding of the content taught at senior secondary education. CK is included subject matter from algebra, arithmetic, and
geometry at senior secondary education of CIHSs. In short, CK is related to mathematical content that is typically taught at CIHSs but required a deep understanding of mathematics and defined as knowledge of the content and teaching of the mathematics subject which is a core element of teachers’ professional competence. Indeed, the school subject is the teacher’s primary field of professional activity (Tenorth, 2006). The COACTIV model of CK focuses on mathematics teachers’ understanding of the mathematical concepts taught in high school. CK is concluded by Baumert and Kunter (2013) as the basic knowledge of the methods of empirical social research. Therefore, CK is operationalized in this study to assess deep understanding of the content of the CIHS mathematics curriculum according to the details provided by Krauss et al. (2013).

The PCK is understood as knowledge of instructional strategies, knowledge of students’ understanding as well as knowledge of the potential of mathematical tasks. In other words, PCK refers to the specific knowledge of how best to shape processes of teaching and learning. Baumert and Kunter (2006) explain that this PCK necessitates mathematical content knowledge as a prerequisite and similarly includes mathematical content knowledge. Nonetheless as a special form, it should be considered a discrete kind of knowledge. In particular, knowledge of the foundations of education can be expected to have indirect effects on teaching practice (Baumert & Kunter, 2013). The COACTIV model of PCK is operationalized on the knowledge of: (i) explaining and representing mathematical contents; (ii) mathematics-related student cognitions (typical errors and difficulties), and (iii) the potential of mathematical tasks (for multiple solution paths). On this line of reasoning, PCK is concluded as general pedagogical knowledge of instructional planning which including meta-theoretical models of lesson planning,
domain-general principles of lesson planning, and instructional methods in the broad sense.

In addition, PPK means the conceptual knowledge relates to the psychology of human development, learning and motivation. Teachers possess this PPK are able to plan instructional methods in the broad sense and create a constructive and supportive learning environment. In particular, PPK in the COACTIV model is defined as knowledge of classroom management and planning of learning opportunities. The facets of PPK include patterns of instructional practice, variation of social forms and methods of learning, rules and routines of effective classroom management, and creating a constructive and supportive learning environment.

On the other hand, counselling knowledge is defined as a socially distributed and largely non-subject-specific form of knowledge that has to be bundled and interpreted for specific addresses in a given counselling situation. In detail, counselling knowledge in the COACTIV model is operationalized as the knowledge of domain-general principles of diagnostic testing and assessment includes four facets namely learning and achievement (basic diagnostic skills), assessment and evaluation of learning processes, feedback, and summative testing and assessment.

Organizational knowledge refers to knowledge of the education system and its institutional framework; management, governance and transparency; the organization and ecology of school; school quality and effectiveness, and theories of schooling. The COACTIV model of organizational knowledge is operationalized as the conceptual knowledge of the foundation of education includes three facets such as: (i) educational
philosophy, educational theory, and the historical foundations of schooling and instruction; (ii) theory of institutions, and (iii) the psychology of human development, learning, and motivation.

CIHS is defined as a type of private high school in Malaysia. CIHS provides secondary education in the Chinese language as the continuation of the primary education in Chinese national-type primary schools. The medium of instruction in CIHSs is Mandarin with simplified Chinese characters writing. There are 60 CIHSs in Malaysia and they represent a small number of high schools in Malaysia.

Mathematics teacher competency was identified as the starting point of the research framework which defined the core task of mathematics teachers and accordingly the development of their teaching abilities or, in a broader sense, of professional competencies. The professional competencies were the key variables of this study and include CK, PCK, PPK, counselling knowledge, and organizational as indicated above. Teaching and the promotion of teaching abilities or professional competencies constitute within the COACTIV model as proposed by Baumert & Kunter (2013). Mathematics teachers’ competencies in the five identified areas of CK, PCK, PPK, organizational knowledge, and counselling knowledge were measured from five perspectives namely their principals, senior assistants, mathematics department heads, mathematics teachers themselves, and their students as well. Figure 1 below shows the conceptual connection of the COACTIV model and mathematics teacher competency in CIHSs.
1.8 Conceptual Framework

The teaching workforce for CIHS is generally made up of three categories namely Diploma, Bachelor Degree and Master Degree holders. There are also a category of teachers who completed seven years of secondary education and are employed as
teachers undergoing a non-residential short course. This was initially done in the initial stages as to produce as many teachers in the shortest time possible so as to cater for the demands of teachers in CIHS for a simple reason that they are not under Malaysian Ministry of Education and as an independent organization teachers are to be sourced out on their own.

Researcher adapted the COACTIV model which was reviewed by Baumert et al. (2010). Baumert et al. used their newly constructed knowledge tests to assess mathematics teachers directly to measure the five components of mathematics teachers professional competence namely CK, PCK, PPK, organizational knowledge, and counseling knowledge. The teacher data was then linked to data on aspects of instruction and student outcomes. Because of the relevancy in term of mathematics teachers’ professional competence, coupled with professional competence is considered as a result or a product of the learning process (Makulova, Alimzhanova, Bekturganova, Umirzakova, Makulova, & Karymbayeva, 2015), researcher decided to adapt the COACTIV model by examining the issue of professional competence in qualitative cross-sectional research. Research utilized multi-cases scenario to study on mathematics teachers’ professional competence in five different perspectives.

There is a broad consensus that knowledge that is declarative, procedural, and strategic knowledge is a key component of teachers’ professional competence. The COACTIV model of teachers’ professional competence adopts three core dimension of teachers’ knowledge namely CK, PCK, and (broadening Shulman’s original definition) general PPK and supplements them by two further dimensions namely organizational
knowledge (Shulman, 1987) and counselling knowledge that professional need in their communication with laypeople (Baumert & Kunter, 2013).

Researcher utilised the COACTIV model to measure the success of teaching practice in terms of mathematics teachers’ ability to initiate and support learning process that enable students to achieve specific pedagogical objectives. According to this model, teachers are responsible, in interaction with their students, for creating learning opportunities that make insightful learning process possible. The COACTIV model is the most appropriate model to use in this study due to this model was developed by Baumert and Kunter (2013) as a specified model of mathematics teachers’ professional competence.

In addition, the COACTIV model is a model of mathematics teachers’ professional competence that is theoretical rooted in the teacher-specific literature on professional knowledge (Bransford, Darling-Hammond & LePage, 2005; Bromme, 1992, 1997; Shulman, 1986, 1987) but that integrates the insights gained from this approach with the literature on professional competence and its assessment (e.g., Weinert, 2001).

Shulman (1986, 1987) proposes three categories of teachers’ knowledge namely CK, PCK, and curricular knowledge. According to Shulman, CK is the structure of subject matter both substantive, as the organisation of facts and ideas, and syntactic, as the set of rules and norms that support the content. CK should also include an understanding of the organisation of content and which concepts or ideas are most central and relevant to a subject matter. PCK is the content knowledge beyond subject matter that Shulman describes as the content knowledge for teaching. PCK includes all the
strategies and representations that make for effective teaching of a content area. This includes a vast body of examples, demonstrations, analogies, and explanations that are specific to the content being taught and that allow for effective learning by the student. It is not simply a list of strategies but a knowledge of how and when to employ them. PCK also includes the understanding and knowledge of student ideas and what makes a subject difficult or easy for students. This includes common misconceptions and methods for recognising and addressing them. Curricular knowledge is equivalent to PPK which refers to a knowledge of the curricular materials available and variety of programmes and resources for teaching mathematics. This includes an understanding of alternative methods and practices for instruction. It includes the knowledge of what have been taught to the students and students’ learning behaviour.

Bransford et al. (2005, 11) developed their theoretical model of teacher qualification which distinguishes three main dimensions: knowledge of learners and their development in social contexts, knowledge of subject matter and curriculum goals, and knowledge of teaching within the context of a normative vision of professional practice that is anchored in a professional community.

Baumert and Kunter (2013) have summarized professional knowledge as follows:

- Professional knowledge is domain specific and dependent on education and training (competence in the narrow sense)
- Professional knowledge is well organized and hierarchically structured.
• In professional domains, important CK and practical knowledge are arranged around key concepts and a limited number of event schemata, onto which individual cases, episodic units, or sequences of episodes (scripts) are docked.

• Professional knowledge integrates different contexts of application and thus allows a rich variety of adaptive behaviours in problem situations.

• Basic procedures are automatized, but can nevertheless be flexibly adapted to the specifics of a given case or context (Hatano & Inagaki, 1986).

This study defines mathematical CK as covering a broad spectrum of mathematical concepts and methods, ranging from an operative command of the mathematical content covered at lower and upper secondary level to a conceptual understanding of the mathematics underlying this content (elementary mathematics from a higher standpoint). Two dimensions of PCK are conceptualized, with a distinction being drawn between teaching-related aspects (e.g., those relating to the curriculum and lesson planning), on the one hand, and learning process-related aspects (e.g., those related to teachers' actual instructional practice), on the other.

The COACTIV conceptualisations of PCK mirror the overarching goal of this study to identify predictors of cognitively activating instruction. The underlying assumption is that the knowledge of teachers is a relevant aspect for the creation of cognitively activating instruction (Baumert & Kunter, 2013).

In addition to the domain-specific knowledge, teachers also need domain-general knowledge of how best to shape processes of teaching and learning, that is, of aspects
covered primarily by the general pedagogical knowledge component (but also the knowledge of learners component) of Shulman’s taxonomy. Particular emphasis was given to the following general pedagogical competencies namely classroom management and orchestration of the learning process, general knowledge of student development and learning, diagnostic skills and assessment of student performance, and professional behaviour in the school content. PPK as a constitutive element of the general pedagogical knowledge and skills was specified by the dimensions of knowledge of classroom management, knowledge of teaching methods, knowledge of classroom assessment, knowledge of students’ learning processes, and knowledge of individual student characteristics (Vose, Kunter, & Baumert, 2011). Conceptualisation PPK is the knowledge needed to create and optimise teaching-learning situations.

Organizational knowledge on the functioning and effectiveness of the education system and its individual institutions is also conceptualized as a separate domain of teachers’ professional knowledge. Organizational knowledge can include knowledge of (i) the education system and its institutional framework; (ii) management, governance, and transparency; (iii) the organization and ecology of the school; the legal form of schools; the rights and responsibilities of students, parents, and teachers; and the role of school management; (iv) school quality and effectiveness, and (v) theories of schooling (Woolfolk Hoy et al., 2006).

Counseling knowledge is a socially distributed and largely non subject-specific form of knowledge that has to be bundled and interpreted for specific addresses may be
individual students or small groups of students or parents/families. Common reasons for counseling include upcoming decisions at critical points in students' educational careers, learning difficulties, and behavioral problems. Counseling situations tend to address people's experiences and behaviors in various areas, beyond a single school subject, and thus require the experiences and diagnostics skills of several adults, both teachers and parents to be activated. They are thematically and socially complex in terms of their preparation, the counseling process itself, and any follow-up measures required. They often also involve decisions on whether or not other institutional partners should be consulted (e.g., psychological or remedial services, child guidance centers, or social services).

In sum, COACTIV model of teacher competence are focused on three domains with direct relevance to teachers' instructional practice, namely CK, PCK, and PPK. Theoretical assumptions were made by Baumert and Kunter (2013) that a well-established body of CK is a necessary condition for the development of PCK and that PCK and PPK are directly reflected in teachers' classroom practice. Whereas PPK was expected to be particularly important for general classroom management and individual learning support, PCK was hypothesized to the key factors determining the potential for cognitive activation.

Some conceptions of COACTIV model have been developed and empirically tested for the subjects of mathematics. The research group comprised of Ball, Bass, Hill, and
Rowan at the University of Michigan has developed a theoretical framework and empirical measures to assess the professional competence of elementary mathematics teachers (Ball, 2003; Ball, Hill & Bass, 2005; Hill, Schilling, Ball, 2004). Ball’s research group sees mathematics teachers’ professional CK as the mathematics they need to know in order to teach effectively. On this basis, Ball et al. (2005) and Hill et al. (2004) distinguish the everyday mathematical knowledge that every teacher should have (common knowledge of content) from the specialist knowledge acquired through professional training and classroom experience (special knowledge of content).

CK is theoretically distinguished from and generally regarded as a necessary condition for the development of PCK. In COACTIV model has distinguished three dimensions of PCK as follow: (i) Knowledge of the didactic and diagnostic potential of tasks, their cognitive demands and the prior knowledge they implicitly require, their effective orchestration in the classroom, and the long term sequencing of learning content in the curriculum; (ii) Knowledge of student cognitions (misconceptions, typical errors, strategies) and ways of assessing student knowledge and comprehension processes, and (iii) Knowledge of explanations and multiple representations.

PPK is knowledge of educational philosophy, educational theory, school theory, and the sociology and history of education. Darling-Hammond and Bransford (2005) and Terhart (2002) have developed similar competence profiles. Teachers need to have knowledge of how children and adolescents think and behave is important as well as understanding differences that may arise from culture, family, community, gender, race,
or other social forces that shape students' worldview (Darling-Hammond & Bransford, 2005). As a result, teachers need PPK to deliver a curriculum with their students' experiences in mind and shape lessons to connect with what students understand about the world around them.

Organizational knowledge of teachers in now intensively applied to the educational setting in order to improve schools' academic capacities. Hence, school leaders need to plan an effective educational system in upgrading the school to be the main source of producing quality students who later serves as the nation's workforce (Mohd Tahir, Ozay, Sumintono & Matzain, 2013). Therefore, schools need to construct knowledge as a main asset to produce an effective and efficient school management as part of their professional development process and internal training in enhancing teachers' competencies. In sum, organizational knowledge is defined as an important approach that endorses the concept of learning organization (Wong, 2008). According to Nnabuike (2012), teacher is a learner and there is no end to learning for teacher.

Teachers need counseling knowledge in order to help students to learn, understand themselves and their environment and be in a position to choose the right type of behaviours that help students develop, grow, progress, ascend, mature and step up, educationally, vocationally and socio personally (Egbo, 2013). In other words, counselling is a transformation process of helping students' learning both inside and outside the school. Counseling knowledge is important in teaching quality because it is a set of
teaching activities that are designed to bring about changes in the behaviour of students (Akinade, 2002) by explaining, demonstrating, guiding and counselling by teachers (Egbo, 2013). This is further supported by Okoye (2010) who stated that the main aim of teaching is to help students acquire or change some skills, attitude, knowledge, idea or appreciation. Teaching is said to be effective only when the students have been able to achieve the set behavioural objectives or bring about some desirable changes in the students.

Researcher adapted this COACTIV model to provide a reference framework for the description of measuring teaching competencies. Such a reference framework represents the interrelationship of the five domains of knowledge mentioned above and gives an orientation as to which knowledge aspects should be covered and how solutions for these knowledge aspects can be found. The COACTIV model supports the development of competency profiles for mathematics teachers (such as CK, PCK, PPK, Organizational knowledge and counseling knowledge). Competency profiles mean that the generic standard is tailored to the needs and requirements of a CIHS. It does not provide specific requirements or rules. Rather, it is a framework to guide teachers through the process of quality teaching in the field of mathematics.
Figure 1.2: The COACTIV Model of Professional Competence
1.9 Conclusion

Researcher attempts to investigate the five components of teaching competencies of mathematics teachers from various perspectives like school principals, senior assistants, mathematics department heads, mathematics teachers, and students will provide sufficient information to improve the quality of the current human resource in CIHS. Additionally, this study demonstrates the possibility and appropriateness of using COACTIV model in studying how mathematics teachers in CIHS conceptualize their own or other teachers’ competency. The study will add to the limited knowledge of CIHS mathematics teachers in Malaysia by giving ‘voice’ to a rather neglected group of teachers. The findings of this study will be able to highlight the expanding view and heightened awareness of the importance on teaching competencies. Improving the quality of education remains a primary concern to anyone who has a passion for education. Research on teaching competencies particularly in CIHS definitely a valuable and worth exploring topic as every students is affected by the quality of teaching which is caused by the effectiveness of the training or professional development provided to teacher.

Chapter 2 starts with the history and characteristics of CIHSs in Malaysia. This is followed by the design and characteristics of training programmes and the importance of teacher competency. Next, empirical research reviews cover teachers’ competencies, teacher competency standard, teacher education training are presented. Finally, theory of
teacher competency as the core of knowledge and teacher competence in educational assessment is discussed in details at the end of Chapter 2.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The content of this chapter is a review of literature on CIHS mathematics teachers’ professional competencies in 13 major sections. Firstly, the review begins with brief history of CIHSs in Malaysia, and is followed by the related theories to mathematics teachers professional competencies and relationship between teachers’ professional competencies and teaching training programmes. Thirdly, the review discusses on the importance of teacher competency. The literature then further discusses related studies on teachers’ professional competencies, teacher professional competency standard, teacher education training, teacher professional competence on educational assessment, and theory of teacher professional competency as the core knowledge. Finally, the conclusion of professional competence of teachers as well as overall conclusion of this chapter is discussed.

2.2 History of Chinese Independent High Schools in Malaysia

Chinese schools were being established by the ethnic Chinese in Malaya as early as the 19th century. The schools were set up with the main goal of providing education in
the Chinese language. As such, their students remain generally Chinese to this day even though the school themselves are open to people of all races and backgrounds. After Malaysia's independence in 1957, the government instructed all schools to surrender their properties and be assimilated into the National School system. This caused chaos among the Chinese and a compromise was accomplished in that schools would instead become ‘National Type' schools. Under such a system, the government is only in charge of the school curriculum and teaching personnel while the lands still belonged to the schools (Wikipedia, the free encyclopaedia, n.d.).

Although Chinese primary schools are allowed to retain Chinese as the medium of instruction, Chinese secondary schools are required to change to English-medium schools. According to the proposal, the medium language for most of the subjects is switched to English but the teaching and learning of Mandarin remained compulsory, with most of them committing at least one seventh to one fifth of their teaching time per week to Mandarin studies in these Chinese secondary schools. This plan was still regarded as an unacceptable compromise amongst some Chinese, and a minority of the Chinese schools refused the proposal and became private high schools as they were later called as Chinese Independent High Schools.

This concept slowly extended popularity and, during the 1960's and 70s, many of the National Type high schools reopened their independent high school branch. Their numbers continued to grow until a period when the political situation in Malaysia made it
impossible to set up additional independent Chinese high schools. Currently there are 61 independent CIHSs in Malaysia.

Development of Chinese Independent High Schools in East Malaysia was growing differently compared to West Malaysia. In 1960, there were 18 high schools using Chinese as the medium of teaching and 22 high schools teaching in the English medium in Sarawak alone. In that year, the British Crown Colony who were then in control of Sarawak proposed that the 18 high schools using Chinese as the medium of teaching converted into using English. In 1961, a letter was sent to all the Chinese-medium high schools demanding them to convert teaching of all subjects into English before 1st April 1962. Failing to do so, the schools would not be given any allocations from the government. Despite strong rejection by the local Chinese community, the plan still took place.

Finally, only six high schools out of the 18 refused to convert to teaching in English remained as CIHSs. They were Chung Hua Middle School No.1, Chung Hua Middle School No.3, Chung Hua Middle School No.4, Guong Ming Middle School, Kiang Hin Middle School and Kai Dee Middle School. The Chinese community not only continued to support the six high schools which retained the teaching in Chinese which founded in between 1945 to 1960, they had even founded another eight high schools from 1962 to 1968. These 14 high schools then became a part of Malaysia's CIHS and still
exist until today. On the other hand, in Sabah, all the nine CIHSs in the state were formed from 1960 to 1969 (Wikipedia, the free encyclopaedia, n.d.).

Being private schools, CIHSs do not receive funding from the Malaysian government, unlike the national type Chinese schools. However, in accordance with their aim of providing affordable education to all the Chinese language, their school fees are substantially lower than those of most other private schools. The schools are kept alive almost exclusively by donations from public. In other words, CIHSs are funded mostly by the Malaysian Chinese public, with UCSCAM also known as Dong Jiao Zong as the overall co-ordination body.

2.3 Characteristics of Chinese Independent High Schools in Malaysia

After receiving primary education in national-type Chinese primary schools (SJKC), some students may choose to study in a CIHS. Students usually spend six years in a CIHS for their studies. The six years are divided into two stages namely three years in junior middle and three years in senior middle, similar to the secondary school systems in mainland China and Taiwan. Students are streamed into two tracks either Science or Art/Commerce in the senior middle stage. However, some CIHSs recently provided unique streams like Electrical Engineering, Food and Beverage Studies or Art Design (The Background of Dong Zong’s Establishment, n.d.). Besides a few CIHSs offer an additional year in senior middle, catering to students taking the government’s Sijil Tinggi
Persekolahan Malaysia or Malaysian Higher School Certificate (STPM) which is equivalent to A-level. As the government of Malaysia does not recognise the UEC, some CIHSs provide instructions in the public secondary school syllabus in addition to the independent school syllabus, thus enabling the students to sit for Pentaksiran Tingkatan 3 or Form 3 Assessment (PT3), Sijil Pelajaran Malaysia or the Malaysian Certificate of Education (SPM), and STPM (Wikipedia, the free encyclopaedia, n.d.).

Students in CIHSs take standardised tests known as the UEC at the end of Junior Middle 3 and Senior Middle 3. UEC has been run by UCSCAM since 1975. The UEC is available in three levels namely Vocational Unified Examination (UEC-V), UEC Junior Middle Level (UEC-JML/JUEC), and Senior Middle Level (UEC-SML/SUEC). The syllabus and examinations for the UEC-V and UEC-JML are only available in the Chinese language. The UEC-SML has questions for mathematics, sciences (biology, chemistry and physics), bookkeeping, accounting and commerce in both Chinese and English.

UEC-SML is recognised as an entrance qualification in many tertiary educational institutions internationally, including those in Singapore, Australia, Hong Kong, Taiwan, Mainland China and some European countries, as well as most private colleges in Malaysia, but not by the government of Malaysia for entry into public universities.

CIHSs use the same academic year as government schools. An academic year consists of two semesters as such Semester 1 from January to May and Semester 2 from
June to November, with examinations at the end of each semester. The overall academic performance of a student in an academic year determines his or her promotion to the next study year in the next academic year. Failing to do so requires the student to repeat the study year. Generally, failing to be promoted for two consecutive years in a low result will cause a dismissal. In contrast, students in government schools are automatically promoted regardless of academic performance (Wikipedia, the free encyclopaedia, n.d.).

The curriculum used in CIHSs is developed and coordinated by the Curriculum Department of UCSCAM with reference to secondary education curricula around the world, particularly Malaysia's national secondary education curriculum and those of mainland China as well as Taiwan. UCSCAM publishes textbooks for use in CIHSs.

2.4 History of CIHS Model in Administering Teachers: Professional Competency

CIHSs are solely governed by The United Chinese School Committees Association of Malaysia (UCSCAM) which coordinates the curriculum used in the schools and organizes the United Examination Certificate (UEC) standardized test. Generally teachers are appointed through individual school administration which is governed by the directors who are the shareholders of the CIHS as they are not governed by any central system. In other word, school management is based on the individual superiors.
Teachers in CIHSs are not employed through the professional teachers training colleges. In order to develop teacher competency, they have to involve in various professional development programmes in school. These programmes were mostly conducted during school hours and often during the school holidays. As a result school administration contributes in moulding and producing teachers who are as competent as the trained teachers by the Teachers Training Colleges under the Malaysia Education System. In organizations like CIHSs, the routines involve being continuously observant about the strength of leadership and teaching on students' involvement academically. To implement this observation, teachers also need to know how to judge students, and the efficiency of all professional activities. Therefore teachers and students in CIHSs solely rely on non-governmental organization to provide relevant professional training and development for further enhancement of teaching outcome. As a result, professional development programmes in CIHSs is believed to perk up the excellence of teaching and the quality performance of students. This provides a basis upon which teachers can improve their instructional competence and pedagogic skills.

2.5 Theories related to mathematics teachers professional competencies

There are three theories underlying mathematics teachers’ professional competence used in this study, namely Shulman (1986, 1987), Richardson (1996), and Schoenfeld (2011). These three theories were used by Baumert and Kunter (2013) in
COACTIV model and researcher utilized the COACTIV model as conceptual framework of this study.

According to Shulman (1986, 1987), pedagogical reasoning and action is related to CK, PCK and PPK that are comprehension, transformation (preparation, representation, selection, and adaptation and tailoring to student characteristics), instruction, evaluation, reflection, and new comprehension. Shulman’s theory was seen as accessible and practical by almost all the teachers, as being robust and adaptable across specialist subject fields, and as having built-in variety through the widely inclusive notions of ‘representational repertoire’ and ‘instructional repertoire’ and combinations of the two.

Basically, Richardson (1996) strongly emphasized the professional beliefs and motivation as mathematics teachers’ professional competence in term of organizational knowledge and counseling knowledge. Understanding teachers’ subject-matter beliefs that are relevant to the design of mathematics teaching lesson can be the components of mathematics teachers’ professional competence (Richardson, 1996). This is supported by Meirinka, Meijerb, Verloopa, and Bergenc (2009) who found that teachers’ teachers’ participation in professional development activities promotes changes in their beliefs about the implementation of reforms thus increase their professional competence.

The main theoretical argument is grounded that mathematics teachers’ behavior in ‘well-practiced’ domains, teaching in particular can be understood as a function of knowledge and resources, goals, and beliefs and orientation (Schoenfeld, 2011). Well-practiced’ domains are those areas of practice in which mathematics teachers have had enough time to develop a corpus of knowledge and routines that shape much of what they
do. The theory is general, but as a mathematics teacher, Schoenfeld’s primary focus is on the improvement of mathematics teaching and learning professional competence. The main goal of this theory is to indicate how the interplay of resources, goals, and orientations results in mathematics teachers’ in-the-moment choices as they teach. That is, although beliefs or more broadly orientations are essential factor in shaping mathematics teachers’ behavior. This is followed by some attempts to use these theoretical ideas to shape mathematics teachers’ professional competence level (Scoenfeld, 2011).

Weinert (2001) revealed the mathematics teachers competencies can be divided into cognitive facets (teachers’ professional knowledge) and affective-motivational facets (professional beliefs). Shulman (1986, 1987) had distinguished mathematics teachers’ professional competence into (i) mathematics CK that consisted of the main mathematical areas relevant for future teachers and mathematics and (ii) PCK that comprised of knowledge of lesson planning and interactive knowledge applied to teaching situations, as well as curriculum knowledge. Shulman (1987) further separated the knowledge facet and the general pedagogical knowledge that included knowledge about teaching and learning and the evaluation of students’ achievement.

In addition, Schoenfeld (2011) pointed out that professional beliefs are crucial for the perception of classroom situations and for decisions on how to act other than professional knowledge that should be possessed by mathematics teachers. Richardson (1996) defined professional beliefs as stable, psychologically held propositions of the world around us, which are accepted to be true. Several belief facets were distinguished
by the experts, particularly in epistemological beliefs about the nature of mathematics and beliefs about the teaching and learning of mathematics. Consequently, belief and affective traits such as motivation abilities and self-regulation are indispensable parts of the professional competencies of teachers.

(Figure 2.1. Mathematics teachers’ professional competencies (Döhrmann et al., 2012: 327)

Döhrmann, Kaiser and Blömeke (2012: 327) pointed out that a successful teaching depends on professional knowledge and teacher beliefs. They framed mathematics teachers’ professional competencies in terms of cognitive and affective motivational facets (Figure 2.1). The theoretical basis of the international study Teacher Education and Development Study in Mathematics (TEDS-M) was underlying their
framework. Döhrmann et al. highlighted CK or subject matter knowledge and PCK in the cognitive aspect, and teachers’ professional beliefs in the affective-motivational aspect, as the most fundamental traits of effective teaching and teacher education.

2.6 In-service Training Programmes of CIHSs and Teachers’ Competencies

In-service training for CIHSs is extremely important and challenging in order to upgrade and develop the teachers’ competencies through a variety of approaches and methods. CIHSs occupy a marginal position with the absence of access to official teacher training, these CIHSs are confronted with shortage of qualified teachers thus competent teachers subsequently will be questionable. New Era College Malaysia is a community-funded tertiary institution to provide training programmes to CIHS teachers. New Era College has co-operated with selected foreign universities to offer training programmes in Mandarin in order to adapt to the needs of CIHS teachers in the areas of education, teaching, and administration. The Department of Education of New Era College has administered under- and post-graduate programmes on teacher training and education in general to upgrade CIHS teachers’ competencies. There are two major aspects that deserve attention are those dealing with the design of systematic training programmes and a three-step training model (Wong, 2015).
2.6.1 Design of Systematic Training Programmes

The administrative team of New Era College has witnessed a deepening commitment among the CIHS in teacher training over the last two decades. This is to ensure the teacher training of CIHS teachers should be in line with the trend of educational reform in many parts of the world. New Era College too has responded accordingly by putting in place collaborative schemes with foreign universities to offer various training programmes to meet the needs of CIHS teachers. Training programmes have been introduced in three broad areas aimed at raising the professional level of teachers, promoting their personal development, and opening access to research-based post-graduate studies.

(a) Training for Professional Advancement

Available statistics compiled by Dong Zong showed that only 1,553 out of 3,936 CIHS teachers possessed professional qualifications in education in year 2013 (Wong, 2015). This number represents only 39.5 per cent of the total CIHS teachers. Besides, this indicates that six out of every ten CIHS teachers have yet to be properly trained to teach professionally.

New Era College had launched a professional diploma in education in 1998, focuses on education per se and to convey teaching skills. The major aim of this training programme is to upgrade basic knowledge in relation to the teaching profession and, through the integration of theory and practice, to enhance the teaching skills of teacher
The curriculum is centred on teaching, with courses on education psychology, principles of education, classroom management and related subjects, and supplemented by observations on classroom teaching in the parent or other schools (Wong, 2015).

Upon completion of the programme, teacher trainees are subjected to teaching inspection by New Era College-appointed observers. These observers are experienced lecturers from local colleges and universities as well as senior teachers from the CIHSs. Teachers are assessed on their competence in combining theoretical principles and real-life teaching practices.

(b) Development-Oriented Training

In recent years, a demand for ‘development-oriented’ training programmes was generated in order to emphasize the importance of teacher competencies. Easy access to knowledge and information on the teaching profession will assist teachers to increase and develop their expertise in teaching and in various forms of ‘school-oriented’ training. The latter is based on the development needs of the school and teachers receive on-the-job training to raise their professional performance.

Based on the special requirements of different CIHSs, New Era College provides guidance and assistance in creating training programmes and in assembling suitable specialists to serve as trainers. The thematic focus of these training programmes falls under four broad categories, namely education, teaching, management, and counseling as shown in Table 2.1.
As a foundation for the practice of teaching, the CIHS is the support for the professional development of teachers. As such training on the job is a way to raise the teachers' self-confidence and to overcome the lack of competence. At the same time, training programmes may permit the CIHS management team and teachers to work together to seek solutions to problems. Likewise, training offers a mechanism by which the potentials of teachers and the resources of each CIHS may be entirely exploited. In short, training is directed to meet specific and practical needs. It is an evitable leaning of development in the training of teachers in CIHS. Between 2010 and 2013, the demand of in-service training has increased significantly from less than a handful of classes in each of the first two years to 21 and 17 respectively in the last two years.

Table 2.1. Thematic Focus of In-service Training Programmes for CIHS Teachers

<table>
<thead>
<tr>
<th>Focus</th>
<th>Area of Emphasis</th>
<th>Number of Programmes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>Educational Management and Leadership</td>
<td>9</td>
</tr>
<tr>
<td>Teaching</td>
<td>Principles of Teaching</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Medium of Instruction</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Teaching Evaluation</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Teaching Observation</td>
<td>5</td>
</tr>
<tr>
<td>Management</td>
<td>School Operation and Management</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>School Crisis and Conflict Management</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Classroom Operation</td>
<td>6</td>
</tr>
<tr>
<td>Counselling</td>
<td>Principles and Practice of Counseling</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Psychology and Emotions of Teachers</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Group Dynamics</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Total of Programmes</td>
<td></td>
<td>55</td>
</tr>
</tbody>
</table>

Source: Department of Education, New Era College, 2013
(c) Towards Post-Graduate Training

An essential component of in-service training takes the arrangement of post-graduate courses. The objective is to nurture the awareness of CIHS teachers on new pedagogic and theoretical understandings and leanings and to increase their capability to explore and reflect on these developments. In year 2003, Dong Zong in collaboration with Central China Normal University in Wuhan had launched a scheme to facilitate the pursuit of higher degrees in education by CIHS teachers during school vacations. In 2008, management of this scheme was transferred to the Department of Education of New Era College. To date, there is a total of six doctoral and 10 master post-graduate candidates have completed their studies while another eight are going to graduate, of whom six are Ph.D candidates.

**Table 2.2. Master Programme in the Area of School Administration**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Administration</td>
<td>2</td>
</tr>
<tr>
<td>Educational psychology</td>
<td>2</td>
</tr>
<tr>
<td>Psychology Development</td>
<td>2</td>
</tr>
<tr>
<td>Topics in Psychological Health</td>
<td>2</td>
</tr>
<tr>
<td>Methods in Educational Studies</td>
<td>2</td>
</tr>
<tr>
<td>Multi-cultural Education</td>
<td>2</td>
</tr>
<tr>
<td>Educational Statistics</td>
<td>2</td>
</tr>
<tr>
<td>Social Psychology</td>
<td>2</td>
</tr>
<tr>
<td>Youth Psychology</td>
<td>2</td>
</tr>
<tr>
<td>Problems of Practical Education</td>
<td>2</td>
</tr>
<tr>
<td>Educational Aesthetics</td>
<td>2</td>
</tr>
<tr>
<td>Action Studies</td>
<td>2</td>
</tr>
<tr>
<td>Moral Principles</td>
<td>2</td>
</tr>
<tr>
<td>Topics in Curricular Studies</td>
<td>2</td>
</tr>
<tr>
<td>Classroom Management</td>
<td>2</td>
</tr>
<tr>
<td>Organizational Psychology</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Credit</strong></td>
<td><strong>32</strong></td>
</tr>
</tbody>
</table>
In year 2008, New Era College had initiated its collaboration with Taiwan’s Zanghua University to pledge a master programme in the area of school management to nurture teachers in management skills. The introductory class was begun in 2011 had successfully attracted 21 candidates. This is followed by 16 and 25 candidates in year 2012 and 2013 respectively. The course of this master study programme consists of 16 subjects conducted at New Era College by academic staff from Zanghua University and a viva voce on the thesis in Taiwan as indicated in Table 2.2. This master programme is planned to serve as the foundation by which to build up an administrative corps of professional personnel in the CIHSs.

2.6.2 Formation of a Three-Step Training Model

Previous training programmes conducted by New Era College had enclosed components integrating the principles of theory and teaching practice. They were often assembled and presented as teaching materials that were not always easy to understand. To be effective, the in-service training programme should be a type of training in which theory and practice is well integrated. It is clearly not desirable and impractical to over-emphasize theories at the expense of practice, while an overdose of practice will marginalize the importance of theory. Hence due attention must be given to the proper integration of the principles of teaching both in theory and practice in order to place in-service training of CIHS teachers on solid ground (Wong, 2015).
Training under this Three-Step Training Model is given equal emphasis on theory and practice involves three aspects of work. Firstly, training is to provide the CIHS teachers with basic theoretical courses. These will emphasize educational psychology, principles of pedagogy, teaching, counselling, issues and trends of education in Malaysia and related subjects as indicated in Table 2.1 and Table 2.2. These courses are aimed to strengthen the teachers’ grasp of the structure of theoretical knowledge in the broad discipline of education. The second step is to provide training on teaching that is relevant to real-life situations and modern needs. This includes teaching practice and observation on performance (refer to Table 2.1). This second step is mainly exposing CIHS teachers to sharpen their practical performance in the classroom. This will enable them to experience how the best practices in teaching may be acquired for their professional development. Finally, CIHS teachers may pursue post-graduate studies and research on specific aspects of teaching and education. They will then start to appreciate the rules and principles of education and thereby to develop their understanding of education issues and related problems. CIHS teachers are expected to equip with these ability and aided by their experience in teaching to be competency. Then CIHS teachers would be better prepared to face the challenges of Chinese education and to formulate appropriate strategies to defend its future.
The Importance of Teacher Competency

Wong Siew Hoong as Director-General of Education, Singapore mentioned about the good work of teachers is a key national asset, and also a reason why Singapore are able to move from the third world to first world in such a short period during his opening address at the Teacher Conference 2016. Wong further emphasized that to deepen knowledge and to re-examine one's perspectives about education, this is an ongoing process to every teacher in Singapore. In other words, teachers are continually looking at bettering themselves in their profession. In short, there is no end to learning for teachers that is lifelong learning. The recent Singapore Teachers' Conference 2016 focuses on how teachers might learn with and from one another on a lifelong journey to provide a better learning experience for their students (Teachers' Conference, 2016).

According to Madam Nadarajah Vijaya Rani, Master Teacher (Geography) at the Standards and Research Branch in the Academy for Singapore Teachers (AST) explained that teachers can apply their learning to promote a collaborative, engaging, and inspiring classroom culture for their students, who are at the heart of all professional learning of teachers. She coordinates the work of the Geography Chapter to support the professional learning of Geography teachers in Singapore (Teachers' Conference, 2016).

Chan Yew Wooi, Director for Professional Development at AST, Singapore explained that the goal of teachers' professional learning is really helping the students learn better. Chan's team focuses on enhancing the professional competencies of
education officers, executive and administrative staff, and allied educators, through the advocacy of professional collaboration and teacher-led professional excellence (Teachers' Conference, 2016).

2.8 Literature Reviews on Mathematics Teachers’ Competencies Research

Teacher Education and Development Study: Learning to Teach Mathematics (TEDS-M) was carried out under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), aimed at evaluating the effectiveness of teacher education in terms of teacher knowledge and teacher beliefs both across countries and specifically on mathematics subject (Blömeke, Hsieh, Kaiser, & Schmidt, 2014; Tatto et al., 2008, 2012). TEDS-M was a large scale assessment of higher education that included direct testing using representative samples covering graduates from 17 countries from East and West. This study encompassed both elementary and lower secondary mathematics teachers. The focus of TEDS-M was prospective teachers in their final year of teacher education who would receive a license to teach mathematics in one of the grades 1 to 4 (elementary school) or in grade 8 (lower secondary school). The two studies had to follow the rigorous IEA quality control mechanisms of sampling nationally representative samples, data collection, coding, and data analysis. About 23,000 prospective teachers participated in the two studies in year 2008. In Germany, a total of 771 future teachers involved in secondary schools while 1032 in the elementary schools. The major concerns of these TEDS-M studies were multi-layered, covering the assessment of future mathematics teachers’ professional competencies as well as the
influence of institutional and national conditions of mathematics teacher education on these competencies.

Kaiser et al. (2017) had carried out a recent research on the professional competencies of mathematics teachers which is characterized by different theoretical approaches on conceptualization and evaluation of teachers’ professional competencies, namely cognitive versus situated approaches. They built on the international IEA Teacher Education and Development Study in Mathematics (TEDS-M) and its follow-up study, TEDS-FU, they compared the cognitive and situated approaches on professional competencies of mathematics teachers. Kaiser et al. discussed on the different kinds of theoretical frameworks and the consequences for the evaluation methods, the strengths, and weaknesses of both approaches. Kaiser et al.’s findings allowed a comprehensive insight into the structure and development of the professional competencies of mathematics teachers, the complex interplay between the different facets of teachers’ competencies and the high relevance of teaching practice for the development of these competencies. Their analysis showed on the one hand that both approaches namely cognitive and situated are needed for a comprehensive description of teachers’ professional competencies. On the other hand, it is shown that both approaches can be integrated in a productive way.

Kleickmann et al. (2012) constructed tests to directly assess mathematics teachers’ CK and PCK which are the key components of teacher competence that affecting student progress. They compared the PCK and CK of four groups of mathematics teachers at different points in their teaching careers in Germany based on the created tests. Confirmatory factor analysis showed that PCK and CK measurement
was satisfactory invariant across the teacher populations considered. As expected by them, the largest differences in CK and PCK were found between the beginning and the end of initial teacher education. Differences in the structure of teacher education were realistically well replicated in participants’ CK and PCK.

Krauss, Baumert, and Blum (2008) investigated the validity of the COACTIV constructs of PCK and CK. The COACTIV tests of PCK and CK had been administered to various ‘contrast populations’, namely, candidate mathematics teachers, mathematics students, teachers of biology, and chemistry, and advanced school students. The hypotheses for each population’s performance in the PCK and CK tests were formulated and empirically tested. Krauss et al. had compared the COACTIV approach with related conceptualizations and findings of two other research groups. Their findings found differences in CK across school types that were in line with the differences in university training provided for teacher candidates seeking to teach at the academic track or elsewhere. External correlations with teachers’ subjective beliefs on mathematics and on the learning of mathematics showed that knowledgeable teachers reject the views that mathematics is just a toolbox and that mathematics can best be learned by careful listening. Their results of structural equation modeling showed that PCK mediated by aspects of the lesson, supports student learning. A solid basis of CK, in turn, appeared to facilitate the construction of PCK. Krauss et al.’s findings are perfectly in line with the theoretical roles that usually attributed to CK and PCK.

Recent researchers have focused on the multidimensional aspects of teacher competency and defined teacher competency as: (i) good teaching, which comprises a
teacher meeting the expectations for the role of teaching (e.g. a degree holder; uses appropriate methodology) and successful teaching which means a positive learning outcome as a result of the teachers’ actions on student learning (Berliner, 2005; Fenstermacher & Richardson, 2005). However, Fenstermacher and Richardson pointed out that good teaching also depends on three other conditions namely willingness and effort by the learner; a social surround of teaching and learning, and opportunity to teach and learn. International dissertation concerned with educational effectiveness has concentrated on the importance of specifying standards of teaching competency and their assessment for teacher accountability and on-going professional development (Griffin, Nguyen & Gillis, 2004; Pimpa, 2005).

Erduran, Tataroğlu, and Alkan (2010) compared the teacher competency levels of in-service and pre-service mathematics teachers. They also helped eliminating possible problems about training of pre-service and in-service teachers. Erduran et al. had carried out a descriptive study with 105 in-service mathematics teachers with various professional experiences levels and 115 pre-service mathematics teachers using the ‘Mathematics Teachers’ Competencies Scale (MTCS)’ as an instrument to collect data. Their results demonstrated that the pre-service teachers possessed higher levels of the measured competencies compared to the in-service teachers both in general and in sub-headings of the scale.

Durkaya et al. (2011) investigated the pre-service secondary school mathematics teachers’ PCK on determinant subject with respect to multiple representation
components. Their study was carried out to 25 pre-service mathematics teachers including 10 females and 15 males. Durkaya et al.’s results revealed that pre-service teachers experienced difficulty in taking determinants and they used numeric and algebraic representations which are the kinds of multiple representations, instead of geometric representations. In addition, their finding found that respondents could not express the definition and the meaning of the determinant completely and they felt that geometric representations only helped them intuitively understand the meaning of the determinant concept.

A study on teaching profession competency of secondary school teachers under the office of Savannakhet Provincial Education and Sport Service, Lao People’s Democratic Republic were carried out by Chaichana and Chusorn (2016). Chaichana and Chusorn had examined the need of teaching competency development and developed guidelines based on the teaching profession competency for secondary school teachers in Laos. They utilized a mixed mode method using survey and focus group interviews to a total sample of 313 from 57 schools. Modified Priority Needs index was used to measure the needs of the development of teaching profession competency. Their findings revealed that there are three aspects of needs of teaching profession competency development namely knowledge about the learners, teachers’ teaching capability, and qualifications and professional ethics with the Modified PNI ranging from 0.53 to 0.67. Findings related to the guidelines for the teaching profession competency development indicated that teachers should organize appropriate learning activities to fulfill the special needs of each learner, teachers should apply knowledge about ICT to learning activities, and school
should organize activities that show mutual respect among learners. Finally schools are recommended to practice educational policy to inculcate proper consciousness by reciting the Buddhist teaching.

A total of 18 beginning teachers in Malaysia were interviewed by Pauline Goh, Saad and Wong (2012) about their own teaching competencies within their teaching profession through a phenomenographic investigation. Their aim was to discover what beginning teachers themselves perceive as competence in relation to what they did everyday as teachers. These beginning teachers were interviewed and the transcripts analyzed to reveal how they perceived the phenomenon of competence. Their results revealed that beginning teachers' conceptions of competence fell into five qualitatively different categories. These five categories are (i) classroom and behavior management; (ii) knowing subject matter; (iii) reaching out for assistance and support; (iv) understanding students, and (v) possessing values of professionalism. Their study could serve as a platform to further outspread beginning teachers' understandings of the teacher profession thus provide the beginning teachers more possibilities to extend their competencies to enable them to continuously develop and create opportunities for their own students.

The new Malaysian Teacher Standards were used by Pauline Goh (2011) to study on improving teacher competence. According to Pauline Goh, teachers have to use the Malaysian Teacher Standards as part of their own self-appraisal and to benchmark their teaching competency against the Malaysian Teacher Standards. Teachers must attempt to
teach in the direction of the new standards and to meet the performance standards eschewed within the guidelines in the Malaysian Teacher Standards. Along the way they must also be able to reason and reflect upon complex problems of practice and improve their teaching (Pauline Goh, 2011).

Ministry of Education, Malaysia had launched Malaysian Teacher Standards in 2009 for the purpose of education transformation. Education transformation is to improve the quality and outcomes of education in Malaysia culminated in the articulation of standards for teachers. Pauline Goh (2012) had proposed three challenges to the Malaysian Teacher Standards system that teacher educators may face. The three challenges are as follows: First, on transforming ingrown beliefs, values, and biased perceptions of teaching that teacher trainees bring to the teaching institution. The second centers on the rhetoric-reality gap of the Malaysian Teacher Standard itself, while the third challenge involves the actual training of teachers. Pauline Goh had outlined several avenues for teacher educators to consider as they set out to better understand and re-design teacher education programmes in this standards-based era of educational transformation on these given three challenges. The discussion of the challenges and the proposed resources to meet the challenges are by no means exhaustive or acts as a conclusion but rather to create awareness for further discussion and analysis of the proposed implications.

Pantić and Wubbels (2010) studied on teacher competencies as a basis for teacher education from the views of Serbian teachers and teacher educators. Pantić and Wubbels
examined teachers' perceptions on the importance of competencies and explored their implications for teacher education. Their study has been designed to ensure that voices of teachers and teacher educators are heard in identification of areas of expertise that make up a competent teacher. They conducted a principal component analysis of the response of 370 teachers and teacher educators in Serbia to a questionnaire about the importance of a number of areas of teacher competence. They identified four areas underlining teachers' perceptions of competencies relating to (i) values and child-rearing; (ii) understanding of the education system and contribution to its development; (iii) subject knowledge, pedagogy and curriculum, and (iv) self-evaluation and professional development. Results of their study indicated that teachers perceived all but the second area of competence as very important, with the fourth scale perceived as of the highest importance. Implications of each area of competence for teacher education were discussed and conclusions were drawn for the development of teacher education curricula.

2.9 Literature Reviews on the Teacher Competency Standard

A new Malaysian Teacher Standards (MTS) was launched in 2009 to establish 'high competency' standards for teaching profession and to increase the status of teachers in Malaysia (Pauline Goh, 2012). There are three domains stated in Malaysian Teacher Standards as such: (i) Professional values within the teaching profession; (ii) knowledge of
understanding of education, subject matter, curriculum, and co-curriculum, and (iii) skills of teaching and learning.

According to the Southeast Asia Regional Standards for Mathematics Teachers (SEAR-MT), the basic of development covers professional knowledge, professional teaching and learning process, personal attributes, and professional communities. In detail professional knowledge refers to knowledge of Mathematics, knowledge of students' learning of Mathematics, knowledge of intellectual quality, and knowledge of ICT. In addition, professional teaching and learning process includes mathematical tasks and discourse, planning for learning process, implementing teaching strategies, monitoring assessment and evaluation, and reflection teaching and learning. Next is personal attributes encompasses personal attributes, personal professional development, and personal responsibilities toward community. Finally professional communities refer to professional ethics, professional communities at schools, and professional communities outside schools (Thien, 2014).

Ministry of Education and Sports of Lao People's Democratic Republic has adopted the Teachers Standards No. 1232/SS.SK/2010 signed by the Minister of Education and Sports on 3rd June 2010, in the capital city of Vientiane, as a guideline for the development of teachers and educational personnel nationwide. The teaching standards consist of three essential traits namely teachers' qualifications and professional ethics, the knowledge about the learners, and teaching capability. Apparently teachers and
educational personnel play the most significant roles in educational development through this Strategic Plan for National Education Standard Reform in Laos. According to Chaichana and Chusorn (2016), we must first take the qualifications of teachers and educational personnel into consideration before commencing the execution of any reform plan activities. The development of teachers' competency is therefore a process or methods that emphasize the enhancement of the teachers and unit personnel's learning, skills, experiences and teaching expertise. Besides, teachers also need to change their attitude in such a way as to have a sense of responsibility for their works so as to make them effective. In order to upgrade the learners' strengths, it depends very much on the teachers' ability to organize learning activities thus promote students' learning (Chaichana & Chusorn, 2016).

2.10 Literature Reviews on the Teacher Education Training

Teacher education training for the initial preparation of teachers in Serbia and other Western Balkan countries has been critiqued in two recent studies (Pantić and Wubbels, 2010; Zgaga, 2006). Two major inadequacies have been identified: (i) teacher education training is predominantly, if not exclusively, focused on knowledge in a subject area, and (ii) teacher education training lacks an emphasis on practical experiences in relation to theoretical contents, topics, and competencies (Zgaga, 2006: 27). Zgaga reported that most respondents from teacher education institutions believed it was time
for a comprehensive reform of curricula, with a view towards enhancing the national education systems and improving their capability with European and international trends.

According to Moon (2007), teacher education training should include the tightness between concern for the status of teachers or the academic status of teacher education on the one hand, and pressures to integrate training into classroom practices on the other. The latter comes from the ministries, schools and sometimes parents, whereas teacher educators are concerned about the status of teacher education given the ‘very different expectations of the academic world’, namely that teachers be strong in research and have a solid theoretical basis for their work. Despite the ongoing debates about the balance between theory and practice in curriculum design, the integration of practical training does not have to be at abnormal with the professional status, as this is not the case with other professions such as medicine and law (Moon, 2007).

Competence-based teacher education training was based on a behavioral model of training and learning and disappeared into the background when criticism of the simple disintegrative stimuli-response (S-R) thinking of behaviorism increased (Biemans, Nieuwenhuis, Poell, Mulder & Wesselink, 2004). Moreover, the installation of competency tests for teachers in entrance, but in particular, in exit examinations, prior to one’s receiving a teaching credential have received much criticism for their norm-referenced, instead of the typical competency-based criterion-referenced approach (Popham, 1986). In the recent competence-based movement, a holistic approach is
normatively put forward. Competence is regarded as the possession and development of integrated skills, knowledge, appropriate attitudes and experience for the successful performance of one’s life roles (Korthagen, 2004).

Struyven and Meyst (2010) had studied on competence-based teacher education in Flanders. Stuyven and Meyst had carried out an online survey inquiry to set up in eight elementary teacher education institutions using two questionnaires. The first type of questionnaire was catered for the final year elementary institution pre-service teachers, who were about to graduate at the time of completing the questionnaire (N = 218). The second type of questionnaire was distributed to teacher trainers throughout the elementary teacher training programme (N = 51). Results of their study indicated that competence-based education training has become a reality in terms of its implementation after the decree was issued for 10 years. However, the process has not yet come to an end. Some competencies were found to be clearly present in the institutions’ policies and practices. For example, teacher as guide to learning and development and teacher as subject expert. On the other hand, some competencies were found to be poorly presented. For example, teacher as partner of parents, external parties, and as a member of the educational community were poorly presented. Moreover, teacher trainers tend to take four different approaches to the implementation of competencies (i) during internship, (ii) through the institution’s policy and programme planning, (iii) by means of their integration in both theoretical and practical components of the curriculum, and finally (iv)
a lack of implementation because the competencies are considered insufficiently applicable by the teacher trainers. In particular, more experienced and subject expert teacher trainers tend to adopt the final approach more than do younger colleagues and educators. Besides findings of teacher trainees showed that important differences between institutions concerning their understanding of competences and the integration of these competencies in the curriculum as well as different paces of adaptation between teacher education institutions. Moreover, even within schools, the trajectory towards implementation is not always clear for all members of the teaching team nor for the students of most teacher education institutions.

2.11 Teacher Competence in Educational Assessment

The American Federation of Teachers National Council on Measurement in Education National Education Association (1990) had completed their reviews of the measurement, teaching, and teacher preparation and certification communities. The committee had intended to guide the pre-service and in-service preparation of teachers, the accreditation of preparation programmes, and the future certification of all teachers. The assessment competencies should be included the knowledge and skills which is critical to a teacher's role as educator. It is understood that there are many competencies beyond assessment competencies which teachers must possess.
2.11.1 Teachers should be skilled in choosing assessment methods appropriate for instructional decisions

Teachers need to be well-acquainted with the kinds of information provided by a broad range of assessment alternatives and their strengths and weaknesses. In particular, teachers should be familiar with criteria for evaluating and selecting assessment methods in light of instructional plans. Teachers who meet this standard will have the conceptual and application skills that follow. They will be able to see the concepts of assessment error and validity when developing or selecting their approaches to classroom assessment of students.

In addition, teachers will understand how valid assessment data can support instructional activities such as providing appropriate feedback to students, diagnosing group and individual learning needs, planning for individualized educational programmes, motivating students, and evaluating instructional procedures. They will understand how invalid information can affect instructional decisions about students. They will also be able to use and evaluate assessment options available to them, considering among other things, the cultural, social, and language backgrounds of students. They will be aware that different assessment approaches can be incompatible with certain instructional goals and may impact quite differently on their teaching.
2.11.2 Teachers should be skilled in developing assessment methods appropriate for instructional decisions

Teachers who meet this standard will have the conceptual and application skills that follow. Teachers will be skilled in planning the collection of information that facilitates the decisions they will make. Teachers will know and follow appropriate principles for developing and using assessment methods in their teaching, avoiding common pitfalls in student assessment. Teacher will select the techniques which are appropriate to the intent of the teacher's instruction.

2.11.3 Teachers should be skilled in administering, scoring and interpreting the results of both externally-produced and teacher-produced assessment methods

Teachers who meet this standard will have the conceptual and application skills that follow. They will be skilled in interpreting informal and formal teacher-produced assessment results, including students’ performance in class and on homework assignments. Teachers will be able to use guides for scoring essay questions and projects, stencils for scoring response-choice questions, and scales for rating performance assessments. They will be able to use these in ways that produce consistent results.
2.11.4 Teachers should be skilled in using assessment results when making decisions
about individual students, planning teaching, developing curriculum, and
school improvement

Teachers who meet this standard will have the conceptual and application skills
that follow. They will be able to use accumulated assessment information to organize a
sound instructional plan for facilitating students' educational development. When using
assessment results to plan and evaluate instruction and curriculum, teachers will interpret
correctly and avoid common misinterpretations, such as basing decisions on scores that
lack curriculum validity. They will be informed about the results of local, regional, state,
and national assessments and about their appropriate use for student, classroom, school,
district, state, and national educational improvement.

2.11.5 Teachers should be skilled in developing valid student grading procedures
which use student assessments

Teachers who meet this standard will have the conceptual and application skills
that follow. They will be able to devise, implement, and explain a procedure for
developing grades composed of marks from various assignments, projects, in class
activities, quizzes, tests, and other assessments that they may use. Teachers will
understand and be able to articulate why the grades they assign are rational, justified, and
fair, acknowledging that such grades reflect their preferences and judgments. Teachers
will be able to evaluate and to modify their grading procedures in order to improve the
validity of the interpretations made from them about students' attainments.
2.11.6 Teachers should be skilled in communicating assessment results to students, parents, other lay audiences, and other educators

Teachers who meet this standard will have the conceptual and application skills that follow. Teachers will understand and be able to give appropriate explanations of how the interpretation of student assessments must be moderated by the student's socio-economic, cultural, language, and other background factors. Teachers will be able to explain that assessment results do not imply that such background factors limit a student's ultimate educational development. They will be able to communicate to students and to their parents or guardians how they may assess the student's educational progress. Teachers will understand and be able to explain the importance of taking measurement errors into account when using assessments to make decisions about individual students. Teachers will be able to explain the limitations of different informal and formal assessment methods. They will be able to explain printed reports of the results of student assessments at the classroom, school district, state, and national levels.
2.11.7 Teachers should be skilled in recognizing unethical, illegal, and otherwise inappropriate assessment methods and uses of assessment information

Teachers who meet this standard will have the conceptual and application skills that follow. They will know those law and case decisions which affect their classroom, school district, and state assessment practices. Teachers will be aware that various assessment procedures can be misused or overused resulting in harmful consequences such as embarrassing students, violating a student's right to confidentially, and inappropriately using students' standardized achievement test scores to measure teaching effectiveness.

2.12 Theory of Teacher Competency as the Core of Knowledge

A declarative, procedural and strategic knowledge is a broad consensus and key component of teachers' professional competence. There is far less agreement about the structure of this knowledge, the different types of knowledge (CK, PCK, PPK, organizational knowledge and counselling knowledge) and their epistemological status, or the development and mental representation of professional knowledge and skills (Ball, Lubienski & Mewborn, 2001).

According to Shulman's (1986) theory to the structure of teachers' knowledge has gained widespread acceptance. Having first distinguished between general pedagogical
knowledge, subject matter CK, PCK and curricular knowledge, Shulman later extended this typology to include knowledge of learners, knowledge of educational context and knowledge of the philosophical and historical aims of education (Shulman, 1987). The distinction between general pedagogical knowledge (PK), CK and PCK has proved practically useful and has been implemented in numerous studies (e.g., Borko, 2004; Borko & Putnam, 1996; Blömeke, Suhl & Kaiser, 2011; Munby, Russell & Martin, 2001).

Fenstermacher (1994) distinguished between formal (theoretical) and practical knowledge. The formal component of teacher knowledge primarily includes CK but also elements of PCK and generic PPK. It is generally assumed that this type of knowledge has a propositional mental representation and can be represented with semantic networks. However, broad areas of teacher practice especially those related to communicative behavior in the class or the school draws on practical knowledge (knowledge in action). Although fastened in academic knowledge, this knowledge is experience based, embedded in specific contexts and related to concrete problems. It is reflected in the quality of professional practice so called as teacher competency. Although this knowledge generally remains implicit in the rapid pace of classroom events, Fenstermacher argued that it can be in principle be justified in practical discourse by the professional teacher (Hiebert, Gallimore, & Stigler, 2002; Munby et al., 2001; Neuweg, 2005: 215f).

Some elements of practical knowledge can also be assumed to have a propositional mental representation. This applies to the act of lesson preparation and
probably also to the categorization of perceived situations and typical sequences of events. This type of knowledge is complemented by knowledge with a strong practical focus that is tied to specific cases, episodes and scripts. It is integrated in routines but is nevertheless flexible enough to allow for intuitive fine-tuning on the job (Neuweg, 2001). It is this fine-tuning so-called intuitive interpretation of specific situations that enables teachers to do the ‘right thing’ at the right time and in a socially and morally acceptable manner (Elliott & Stemler, 2008; Gigerenzer & Brighton, 2007; Helsper, 2007).

The theory of planned behavior is a theory links beliefs and behavior which was proposed by Ajzen (1985), utilized in counselling knowledge competency. The concept is to improve on the predictive power of the theory of reasoned action by including perceived behavioral control. It is a theory explaining human behavior. It has been applied to studies of the relations among beliefs, attitudes, and behavioral intentions. The theory states that attitude toward behavior, subjective norms, and perceived behavioral control, together shape an individual’s behavioral intentions and behaviors.

In conclusion, researcher utilized this theoretical COACTIV model to focus primarily on teachers’ theoretical, formal knowledge to assess their competencies together with their conceptual understanding of mathematics. In the domains of PCK and generic PPK, researcher also sought to assess elements of practical knowledge.
2.13 Professional Competence of Teachers as a Multidimensional Construct

In this chapter, researcher drew on the teacher-specific literature on professional knowledge as well as on the research literature on competence as a precondition for adaptive and effective professional practice to derive a general model of teachers' professional competence, and researcher showed how the COACTIV was specified to apply to mathematics teachers in the context as indicated in Chapter 1. This specification provides the basis for the empirical testing of the competence model described in later chapters of this study.

The model of teachers' professional competence developed in COACTIV (Baumert & Kunter, 2006) draws on various research traditions that have examined the characteristics of a successful teacher from different perspectives. By emphasizing knowledge as a key dimension of teacher competence, the COACTIV model builds on the expertise research on the teaching profession conducted by Berliner (2001), Bromme (1997), and Leinhardt and Greeno (1986). Research on teachers' belief also has a long tradition (Calderhead, 1996; Pajares, 1992). Both research strands share a focus on teachers' cognitive characteristics that, despite differing in their requirements for justification.

Nevertheless both knowledge and beliefs are mental representations constructed by teachers in explicit and implicit learning processes and have much in common. For
example, the idea that knowledge and belief systems become better differentiated with increasing teaching experience and that more differentiated schemata are associated with the ability to act adaptively and flexibly applies equally to both knowledge and beliefs, prompting researcher to subsume both aspects under the label ‘expertise’ (Shulman, 1986; Woolfolk Hoy et al., 2006). The emphasis on these cognitive characteristics, which are subject to processes of learning and change, clearly runs counter to the traditional understanding of the teaching profession as an ‘art and craft’ (Lieberman & Miller, 1992), which emphasizes talent or inborn dispositions.

The COACTIV model of teachers’ professional competence also assumes that the individual competencies are, in principle, teachable and learnable and subject to processes of change. However, the COACTIV model also takes non-cognitive characteristics such as motivational orientations and self-regulatory skills into account and thus goes beyond the conventional understanding of expertise.

To date, research taking a psychological perspective on the teaching profession has paid far more attention to teachers’ motivational and self-regulatory characteristics than to their cognitive characteristics. However, most of these studies have taken a non-profession-specific approach, taking little account of the specifics of the teaching profession in their analysis of how these characteristics relate to, for example, general work-related behaviour (e.g. career decisions, general work engagement), occupational well-being, or the experience of strain (e.g., Butler, 2007; Watt & Richardson, 2007).
In COACTIV, Baumert and Kunter (2006) drew on the constructs established as indicated in this research framework but reinterpreted them by explicitly examining their relevance to the core business of teachers, namely, teaching as a criterion for the ability to cope successfully with the demands of the profession. A key premise of the theoretical approach taken in COACTIV model is that individual attributes in both areas, namely, cognitive characteristics such as knowledge and beliefs as well as motivational or self-regulatory characteristics that provide the necessary basis for effective teaching practice over the long term. Baumert and Kunter did not see these characteristics as innate or immutable, but as the products of processes of professional development that begin with teacher education and continue throughout the teaching career (Terhart, 2001). With its emphasis on the teach ability and learn ability of aspects of professional competence, the COACTIV framework model thus built on teacher education research and on the literature on professionalization in the teaching profession (Cochran-Smith & Zeichner, 2005; Darling-Hammond & Bransford, 2005; Kennedy et al., 2008).

2.14 Conclusion

In conclusion to this chapter, further study on the research background and related topics and issues has been made. Most importantly, extensive review on literature has been undertaken to broaden the view on past or related researches, to examine, compare the findings and identify information. Empirical researches help to shed light on the
importance of teachers' competencies, related to teacher education training and students' learning performance. In the next chapter, the research methodology would be discussed in details so as to guide the implementation of research.
CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodology that was used in obtaining data so as to achieve the purpose of this study. Specifically, this chapter presents description of research design, location of the study, population and sampling, instrumentation, pilot studies, data collection procedures, and data analysis procedures. At the end of this chapter, the conclusion is discussed.

3.2 Research Design

The decision of using what kind of research design depends on how researchers are seeking ways to answer research questions. Specifically, the choice of research approach to be used is based on research problem, personal experiences, and the audiences for whom one seeks to write (Creswell, 2003). To answer the research questions of this study, researcher employed case research design in this study.

Case study research design serves as a useful tool for investigating trends and specific situations in many scientific disciplines especially in social sciences, psychology,
anthropology and ecology. The advantage of case study research design is that researcher can focus on specific and interesting cases. This case study is designed to describe the behavior of the mathematic teachers group as a whole, not the behavior of each individual in the group.

The types of case study is the exploratory case studies serves as a source for developing ideas that are then subjected to further research investigation (Stebbins, 2001). The goal of exploratory case studies is to discover ideas and insights. Exploratory case study is regarded as the most useful in the preliminary stages of a research project when there are levels of uncertainty and general ignorance of the subject (Webb, 1992). Exploratory case study is conducted to provide a better understanding of a situation and is not designed to come up with final answers or decisions. It allows the researcher to explore individuals or organizations through complex interventions, relationships, communities, or phenomenon in which it occurred (Yin, 2003).

Exploratory case study is found to be suitable for this study because the teacher competency problem has not been studied particularly in CIHSs. Researcher initiated an exploratory and multiple case study research project designed procedure. Firstly, researcher reviewed available literature, existing competency model and theories as well as data. Secondly, researcher had in-depth interview with principals, senior assistants, mathematics department heads. Finally, focus group interviews were carried out mathematics teachers and students of the five CIHSs in Penang. Researcher explored the
opinions from various perspectives of information providers as mentioned above in order to explore mathematic teachers’ competencies in the areas of CK, PCK, PPK, organizational knowledge, and counseling knowledge. By using the multiple case study, researcher investigated how complex the phenomenon of teachers’ competencies in CIHSs in a unique and comprehensive manner. In the current context of fast paced change, uncertainty and ambiguity, teachers’ competencies and roles in CIHSs assume great significance.

In this study, the multiple case study design was used for twin purposes of capturing rich descriptive contexts of the teachers’ competencies (Vohra, 2014) and strengthening the patterns of findings using Yin’s (1984) replication logic. Multiple case study are often used as a sort of research design besides other qualitative research methodology because they are intensively descriptive and analyse a single unit or bounded system (Cohen, Manion, & Morrison, 2000). In this study, the single unit appeared to be the single group of the CIHS mathematics teachers in Penang Island. Multiple case study design would contribute to the knowledge of the researcher, the management and institution on the individuals, the environment, and related phenomena (Robert, 2009). From the case study, the researcher could probe into the behaviors, thoughts or feelings of individuals in that natural setting. According to Cohen, Manion, and Morrison (2000), case study data is strong in reality, it also can stand for something of the discrepancies or conflicts between the viewpoints held by participants, and it's ‘a step
of action. Subsequently, the insights garnered from the case study could contribute to policy, practice, and future research (Merriam, 1998).

The methodology, based on the social phenomenology paradigm, used interviews to capture the interpretation of the school principals, senior assistants, mathematics department heads, mathematics teachers and students about mathematics teachers’ competencies in their teaching profession. Qualitative data was collected through a series of in-depth interviews with principals, senior assistants, mathematics department heads as well as focus group interviews with mathematics teachers and students. This design was representing a broad range of opinions towards mathematics teachers’ competencies.

Furthermore, in order to ensure trustworthiness of the results, research methods triangulation was made. Data collection strategies were also triangulated with some quantitative data in this qualitative research approach. By practicing triangulation, that would basically enhance the validity of qualitative research (Gay, Mills, & Airasian, 2011). According to Gay, Mills, and Airasian, this is where the strength of qualitative research which lies in the triangulation of multiple methods, data collection strategies and data sources to acquire a more thorough picture of the topic under study and also to cross-check information.
3.3 Location of the Study

The location of this study was all the five CIHSs in Penang, Malaysia namely School A to School E. This location of study was selected after employing geographical cluster sampling. Another reason for selecting this location was because of this location has the most CIHSs in its cluster and relevant to the study. These CIHSs used the same syllabus and curriculum content, with similar classroom setting and instructional policies offered in the country. As such, the samples of these CIHSs were appropriate to be used in this study.

School A is located at Jalan Han Chiang, Penang. The school was founded in 1950 by the Teow Chew Association of Penang and a local businessman, Lim Lean Teng who gave the school and Han Chiang Primary School a piece of land measuring 33 acres (130,000m²). This school is the first private Chinese school in Malaysia to be founded. The school had about 1000 students in the past decades but it has recently soared to approximately 2000 students due to the availability of the International General Certificate of Secondary Education (IGCSE) British course. One third of the student population hail foreign countries such as Thailand, Indonesia, Korea, Japan, China, Hong Kong, Taiwan, Singapore etc. On 15th August 2009, the Ministry of Education granted School A, a 5-star school because of its facilities and courses given. Among 228 schools tested, School A was ranked 19. Additionally, School A was ranked 8th among 22 private
schools. This school holds an entrance examination annually. Students who wish to attend School A would have to take and pass before getting to enrol.

School B is located in Bukit Mertajam, Penang. It provides various education levels from Junior 1 to 3, Senior 1 to 3. The school also offers UEC for both junior and senior education students and optional choice of PT3 for juniors and SPM for seniors. This CIHS was bestowed ‘5 star private education’ by Ministry of Education, Malaysia on 22nd July 2013.

School C is located at Jalan Air Itam, Georgetown, Penang. Its affiliated schools are Chung Ling High School and Chung Ling Butterworth High School. The school was established in 1962 to accept those student whose age were over the limit and those who wished to receive their education totally in their mother tongue.

School D is located at No.2, Jalan Gottlied, Georgetown, Penang. It is the only all-girls CIHS in Malaysia. It offers a 6-year course which allows students to take either an internationally recognized examination named UEC or the Malaysian government examination called PT3 and SPM. Hokkien immigrants from China first built Penang Fukian Girls' High School in 1919. In 1920, there were 52 students. After several change of location due to the increase of students, the school was forced to a temporal hiatus in 1941 because of the Second World War. It resumed teaching in 1945. It was finally named Penang Chinese Girls' High School in 1951. In 1962, Penang Chinese Girls' High School
accepted the change of systems. The Chinese-based kept under a different name, thus Penang Chinese Girls' Private High School.

School E is located at 19-A, Jalan Bagan Jermal, Georgetown, Penang. The school is named after Bodhi which means enlightenment in Sanskrit. The Phor Tay family consists of four schools, namely Bodhi Kindergarten, Boghi Primary School, Bodhi National Type Secondary School, and Bodhi Private High School. The Phor Tay Institution was founded in 1935 by a young bhikkhuni named Fang Lian from Xiamen, China. Her three main purposes for setting up the Phor Tay Institution were stated as propagating the Buddhadharma, helping the orphans and promoting the Buddhist education. After the demise of Fang in 1939, her followers continued her mission and also initiated secular education through free school. The school was shut down during the Second World War. In 1962 the secondary school also accepted similar offer from the government and split into Phor Tay National Type Secondary School and Phor Tay Private High School. The national type secondary school was formed by the lower secondary classes, the upper secondary science and art classes of the original school. The upper secondary commerce class however retained its independent status and became the Phor Tay Private High School.
3.4 Population and Sampling

Sampling is the process of obtaining information about the entire population that is 60 CIHSs in Malaysia by examining only five CIHSs of it. As the magnitude of operations was small in five cases, so data collection and analysis would be carried out accurately and efficiently. Researcher employed a multi-stage sampling technique utilizing geographical cluster sampling followed by purposive sampling technique to select the five research CIHSs.

Researcher started with probability sampling method, namely, geographical cluster sampling technique. This sampling technique was employed, in which the sampling units were not individual elements of the population, but group of individuals or group of elements were selected as sample. This is because of the 60 CIHSs are scattered unevenly throughout Malaysia and it is not practical to make a list of the entire population from which to draw a simple random sampling. Firstly, researcher compiled the CIHSs into four clusters namely north, central and south of Peninsular Malaysia, and east Malaysia according to their location (Table 3.1). In geographical cluster sampling, the total population was divided into four relatively small sub-divisions which were themselves clusters and then some of these clusters were randomly selected for inclusion in the sample. Under this sampling design, every zone of the entire population had an equal chance of inclusion in the sample. Lottery method was used to select a zone from the four zones in a box with folded eyes as unbiased method. It was the best process of selecting representative sample. The north zone was randomly selected by researcher from the lottery method.
This is followed by purposive sampling which is a non-probability sampling method. Samples were selected deliberately by the researcher instead of using the techniques of random sampling. Based on the summary in Table 3.1 below, researcher selected the sample with a purpose that the highest number of CIHSs located in that particular state would be the priority consideration taken for the research and believed it as typical and representative the north zone. On this line of reasoning, Penang state with a total of five CIHSs was purposely selected to represent the north zone.

There were five groups of population namely, principals, senior assistants, mathematics department heads, mathematics teachers and students of the five CIHSs in Penang. Purposive sampling and snow ball sampling techniques were used because researcher believed these selected informant groups can offer insights into the question of ‘why’ mathematics teachers engaged in particular actions or behaviors that reflecting their competencies. The rationale of using purposive sampling because it is a sampling technique in which researcher relies on his sound judgement when choosing samples of
population to participate in the study who he believed that they are the source for information-rich cases for in-depth study (Patton, 1990). In addition, purposive sampling method has proved to be effective when only limited numbers of people can serve as primary data sources due to the nature of research design and aims of the study.

Firstly, researcher determined the appropriate sample size for in-depth interviews as three groups of mathematics teachers’ direct leaders, namely their principals, senior assistants, and mathematics department heads. A total of 15 informants comprised of these three groups involved in in-depth interviews. This is an important step in the research process because this perspective qualitative method would provide researcher a way to get an in-depth understanding of the underlying reasons, attitudes, and performances behind various behaviors to indicate the competency level from the five specified areas of knowledge.

Secondly, researcher selected sample size of mathematics teachers depending on the school size using snow ball sampling. School A, B, and C are considered as large size CIHSs with a total number of students more than 1,500 while school D and E are small size CIHSs with a total number of students less than 1,000. The snow ball sampling technique is a socio metric sampling technique used by researcher to select mathematics teachers and senior secondary education students to participate in the focus group interviews. This sampling technique is suitable for diffusion of knowledge and skills because it provides the balance between the need to obtain a rich experiential description from interviewees, without sacrificing the equal representation of experiences across the population of possible participant (Patton, 2002). Those mathematics teachers and
students were selected according to the recommendations made by their senior assistants or mathematics department heads, until the informal relationships converge into some type of a definite social pattern.

All the five principals, senior assistants, and mathematics department heads from the five CIHSs in Penang were selected to involve in in-depth interviews in this case. On the other hand, two to three mathematics teachers from each CIHS were purposively called upon for focus group interviews. The criteria was to select a group of representative mathematics teachers who are experienced and directly dealt with the students so as to be able to provide necessary information in details, more elaborative and appropriately. They have been in the CIHS for a number of years and are very much familiar with the setting and environment.

As for the students sampling, five to seven senior secondary education students from each CIHS were invited for focus group study so as to investigate comprehensively into their viewpoints, beliefs, feelings, and behaviours in relation to the their mathematics teachers' competencies. In the process of selection, the researcher did look into their past academic performance, involvement in previous mathematics activities or projects, internal or external mathematics examination, etc.
<table>
<thead>
<tr>
<th>CIHS</th>
<th>Total</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal</td>
<td></td>
<td>P1</td>
<td>P2</td>
<td>P3</td>
<td>P4</td>
<td>P5</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior assistant</td>
<td></td>
<td>SA1</td>
<td>SA2</td>
<td>SA3</td>
<td>SA4</td>
<td>SA5</td>
</tr>
<tr>
<td>Head department</td>
<td></td>
<td>DH1</td>
<td>DH2</td>
<td>DH3</td>
<td>DH4</td>
<td>DH5</td>
</tr>
<tr>
<td>Teacher</td>
<td></td>
<td>T1T2T3</td>
<td>T4T5T6</td>
<td>T7T8T9</td>
<td>T10T11</td>
<td>T12T13</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td></td>
<td>S1-S5</td>
<td>S6-S10</td>
<td>S11-S15</td>
<td>S16-S20</td>
<td>S21-S27</td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td></td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

### 3.5 Instrumentation

In-depth interviews instrument consisted of the posing of open-ended questions and follow-up probes designed to obtain in-depth understanding of informants’ experiences, perceptions, opinions, feelings, and knowledge (Patton, 2002). Focus groups instruments were structurally similar to in-depth interviews in the sense that they were comprised of open-ended questions designed to capture the in-depth teaching and learning experiences of the mathematics teachers and senior secondary education students respectively (Austin & Sutton, 2014). The three instruments used in this research were (i) structured interview protocol for principals, senior assistants, and mathematics department heads; (ii) structured interview protocol for mathematics teachers, and (3) structured interview protocol for students.

Since qualitative research is being more open and fluid, the in-depth interview and focus group questions need to be carefully designed by researcher. The interviewing
process is a flexible and powerful tool to capture the voices and the ways people make meaning of their experience (Rabionet, 2011). Therefore, the quality of data received from in-depth interview and focus group interview was dependent upon the level of thought put into the development of questions posed to interviewees (Rosenthal, 2016). A structured interview is a qualitative method of inquiry that combines a pre-determined set of open questions with the opportunity for the interviewer to explore particular themes or responses further.

There were six kinds of open-ended questions interview questions which encompassing the five main areas of mathematics teachers’ competencies, namely, CK, PCK, PPK, organizational knowledge, and counselling knowledge: (i) experience or behaviour questions; (ii) sensory questions; (iii) opinion or value questions; (iv) knowledge questions; (v) feeling questions, and (vi) background or demographic questions. The interview questions for CK were designed to measure the mathematical content that is typically taught at CIHS syllabus and required a deep understanding of mathematics. The interview questions used for PCK were designed to measure the knowledge of teacher to (i) explain mathematical situations or to provide useful representations, analogies, and illustrations for examples (facet instruction); (ii) detect, analyse or predict a typical student error or comprehension difficulty (facet students), and (iii) write down as many different solutions as possible for a problem (facet tasks) (Krauss, Baumert, & Blum, 2008).

Experience or behaviour questions were designed to get at an interviewee’s actions, either past or present. An informant’s responses should reflect a direct
observation that could have been made by watching the mathematics teachers. These kinds of questions were followed by sensory questions. This is particularly useful questioning strategy because sensory questions focus on things or activities that the interviewee physically experienced, and can help them to better remember other experiences, or behaviours. Opinion or value questions were designed to elicit interviewees’ understanding of a particular phenomenon or experience, and provide specific insight into their goals and intentions. Knowledge questions seek factual from interviewees (Patton, 2002).

Feeling questions were slightly different than opinion or value questions as they were intended to elicit a description of an emotion from the informants. As such, it was particular important for researcher to develop the wording of these questions. Finally, background or demographic questions allowed for researcher to characterize the informants. In general, these background or demographic questions were kept to a minimum as they could be interpreted as boring and potentially insulting to informants.

All the three instruments covered the five major areas of knowledge as follow: (i) CK covered the teaching related aspects like curriculum and lesson planning and learning process-related aspects like teachers’ actual instructional practice; (ii) PCK covered how mathematics teachers shape their teaching and learning process, their abilities in classroom management, their planning of learning process, their knowledge of student development, their diagnostic skills or competencies toward those weak students, and their competencies on assessment of students’ performance; (iii) PPK covered mathematics teachers’ knowledge of classroom management, teaching methods, classroom assessment, students’ learning process, and individual student characteristics;
(iv) Organizational knowledge covered mathematics teachers’ knowledge of education system and its instructional framework; management, governance, and transparency; the organization and ecology of the school; the legal form of school; the rights and responsibilities of students, parents, and teachers, and the role of school management, school quality and effectiveness, and related theories of schooling; (v) Counselling knowledge covered mathematics teachers’ competencies in making upcoming decisions at critical points of students’ educational career; in dealing with students with learning difficulties, behavioural problems, to whom they should consult when they make decisions.

In collecting data, structured interview was employed on principals, senior assistants, and mathematics department heads who were the information providers of the interviews. A total of 15 interviews cycles were carried out to obtain information from these information providers. Feedback of these mathematics teachers’ leaders from interviews sessions would provide useful information towards the focus interview protocol used for mathematic teachers and students.

Interview questions were carefully planned by the researcher. The questions used in the interview session were structured in such a way to enable the researcher to collect data on views and opinions about mathematics teachers’ competencies in (i) deep understanding of school mathematics; (ii) explanatory knowledge; (iii) knowledge of students' mathematical thinking; (iv) knowledge of mathematical tasks; (v) knowledge of student assessment; (vi) knowledge of learning processes; (vi) knowledge of effective
classroom management; (viii) organizational knowledge, and (ix) counselling knowledge. Pre-established interview questions for focus group interview were provided to the information providers prior to the interview session and the mathematics teachers and students were asked to review the focus interview questions. During the focus group interview session, the researcher posed all the questions to the information providers. The questions were asked in sequence as planned by the researcher.

3.6 Pilot Study

A pilot study is often used to test the design of the full-scale study which can then be adjusted (Billé, 2010). The importance of pilot study that is to identify any possible flaws in the instruments from the perspective of its clarity and adequacy in terms of the language, content items, constructs or variables, etc. (Gay, Mills, & Airasian, 2011). It could also serve as preliminary data to check whether the sampling and technique are effective.

3.6.1 Validity

Validity is aimed to ensure that the interview protocol has tapped the mathematics teachers’ competencies concept it sets out to measure by including an adequate representation of items that operationalize the five areas of knowledge (content validity),
differentiates items on an adequate criterion (criterion related validity) and ensures that the measure used fits around the COACTIV model for which the test is created (construct validity) (Ghauri & Gronhaug, 2005; Sekaran, 2003). The pilot study was therefore a try-out of the interview protocol developed to a panel of three experts consisting of two language teachers and a senior lecturer from School of Educational Studies for the three types of structured interview questions. The two teachers included a mathematics teacher with twelve years of teaching experience in the language; an English Language teacher with a doctorate degree in the field of TESOL with teaching experience of more than twenty years, and the senior lecturer with expertise in Educational Management.

The expert panel assessed whether each questions gives adequate range of responses, checked that all questions are relevant, and re-word the questions. From the Feedback and comments from the experts were obtained. Based on the expert’s comments and feedback, revisions to the interview questions were made such as clarity of specific terms, adding more probe questions as shown in Table 3.3.

Table 3.3: Amendments made on the Instruments

<table>
<thead>
<tr>
<th>Set</th>
<th>Interview protocol</th>
<th>Original items</th>
<th>Amended items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In-depth interview</td>
<td>Q1: Do your</td>
<td>Q1 a. Do your</td>
</tr>
<tr>
<td></td>
<td>to principal, senior</td>
<td>mathematics</td>
<td>mathematics</td>
</tr>
<tr>
<td></td>
<td>assistant, and</td>
<td>teachers possess sufficient CK?</td>
<td>teachers possess sufficient</td>
</tr>
<tr>
<td></td>
<td>mathematics</td>
<td>a. Teaching</td>
<td>knowledge related to content</td>
</tr>
<tr>
<td></td>
<td>department heads</td>
<td>related aspects</td>
<td>such as mathematic concepts and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Learning</td>
<td>operative command of the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>process-related</td>
<td>mathematical content?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>aspects.</td>
<td>b. Do your mathematics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>teachers know about learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>process-related aspects, for</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>example mathematical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>concepts and operative</td>
</tr>
</tbody>
</table>
2. Focus group interview to mathematics teachers

Q4: How about your organizational knowledge?
   c. Your knowledge of organization and ecology of the school.

Q4: How about your organizational knowledge?
   Your knowledge of organization and ecology of the school; For example: the legal form of school; the right and responsibilities of students, parents, and teachers, and the role of school management.

3. Focus group interview to senior education students

Q1 to Q5
   Do your mathematics teachers possess CK?
   Do your mathematics teachers possess PCK?
   Do your mathematics teachers possess PPK?
   Do your mathematics teachers possess organizational knowledge?
   Do your mathematics teachers possess counselling knowledge?

Q1 to Q5
   Do your mathematics teachers know a lot of the content?
   Do your mathematics teachers use many different methods to teach you?
   Do your mathematics teachers understand you?
   Do your mathematics teachers organize his or her work well? How he or she organize teaching?
   Do you always seek for consultation from your mathematics teacher?
   When you have problems in learning mathematics, do you look for help from your mathematics teachers?

3.6.2 Reliability

Pilot study was carried out to determine the feasibility of the interview questions to confirm the reliability of instruments. Pilot studies for three types of interview protocols
were conducted in the five CIHSs. Researcher administered the interviews to the pilot subjects in exactly the same way as it will be administered in the actual study. After that, researcher asked the subjects for feedback to identify ambiguities and difficult questions. Researcher recorded the time taken for the three interview cycles to different groups of subject and decided whether it was reasonable. Finally, researcher discarded all unnecessary, difficult or ambiguous questions. Participants in pilot study were a senior assistant, three mathematics teachers and five senior secondary students who were not part of the actual sample in this study.

In this study, pilot interviews were conducted with selected participants from the a senior assistant, mathematics teachers group and student group with a ratio 1:3:5. First interview was conducted to a senior assistant and lasted for 57 minutes; the second interview was conducted to in a group of three mathematics teachers and lasted for 55.13 minutes; while the following interview with five students lasted for 41.21 minutes. The students were given 5-10 minutes of preparation time prior to commencement of interview sessions.

In overall, all of the participants were able to provide responses and information related to the interview questions in the pilot interview. However, students must be guided and probing questions provided the necessary directive measures in this matter. Some prior explanation and emphasis on certain competencies, words or terms were necessary to ensure the students responded to the questions correctly. Besides that, it was
noted also that the respondents in a small group of two persons were more interactive and pragmatic throughout the interview compared to individual face-to-face approach.

3.7 Data Collection Procedures

Data collection took place upon completion of research proposal and pilot study. Data was collected in two phases. Phase 1 was the in-depth interviews with mathematics teachers' leaders including their principals, senior assistants, and mathematics department heads. The second phase was focus group interviews with mathematics teachers themselves and their students. The in-depth interviews with principals, senior assistants, and mathematics department heads and focus group interviews with two or three mathematics teachers and five to seven students of each CIHS almost simultaneously.

The chosen information providers including a principal, a senior assistant, and a mathematics department head of each CIHS were invited for about an hour's in-depth interview sessions with researcher for compilation of qualitative data from mathematics teachers' leaders' perspectives. On the other hand, two to three chosen mathematics teachers, based on their experience and involvement in Senior Secondary Mathematics Education and their five to seven students were invited for also about an hour's focus group discussion with the researcher for complication teachers own opinions and their students regarding teachers' competencies. The topic and objectives of the research were explained, confidentialities were assured, and introduction was made before directing
open-ended questions to the interviewees. Highlights of the interviews were noted down and processes taped for preciseness and reference of interpretation later on. Each respondent was given a token of appreciation upon completion of the interview session. The data collection procedure is shown at Figure 3.1 below.

**Figure 3.1: Data collection procedure**

Appointments to have interview session either in-depth interviews or focus group interviews with the particular information providers were made. Then notification on the intention of the researcher was communicated to the 10 information providers who participated in interviews. The pre-established focus group interview questions were provided to the mathematics teachers and students prior to the interview sessions and the
mathematics teachers and students were asked to review the interview questions. When the appointment date arrived, the researcher used the pre-established interview questions to conduct the focus group interview sessions. The intended data collected from structured focus group interviews was the overall view of mathematics teachers and students related to mathematic teaching and learning process in the classroom. Probing techniques were used to pose interview questions to obtain ideas and suggestion on real situation. The aim of probing was to test mathematics teachers' teaching competencies without they were aware of.

3.8 Data Analysis

Data collection and analysis must be implemented simultaneously in qualitative research (Merriam, 1998). Qualitative data analysis involves classifying things, persons, and events and the properties that characterize them. The method used in this study was thematic analysis. Thematic analysis is a method of identifying, analysing, and reporting patterns (themes) within data (Braun & Clarke, 2006: 79). In this study, the areas entailed mathematics teachers' competencies in CIHSs from the five perspectives of principal, senior assistant, mathematics department head, mathematics teacher, and students.

Content analysis is a research tool used to determine the presence of certain words or concepts within texts and sets of texts. Thematic analysis is closely related to content analysis and it goes beyond identifying and analysing to interpreting various aspects of
research topic (Boyatzis, 1998). Researcher quantifies and analyses the presence, meanings and relationships of such words and concepts, then make inferences about the messages within the texts. Firstly, the researcher would transcribe all the data collected from the interviews to get a general sense of the whole and ideas presented. To conduct a thematic analysis on such text, the text is coded, or broken down, into manageable categories on a variety of levels, i.e. word, word sense, phrase, sentence, or theme, and then examined using conceptual analysis.

Researcher used open coding to tabulate by looking for distinct concepts and categories in the interview data, which would form the basic units of the analysis. In other words, researcher broke down the data into first level concepts, or master headings, and second-level categories, or subheadings. Researcher used highlights to distinguish the concepts and categories. For example, if interviewees consistently talk about teaching methods, each time an interviewee mentions teaching methods researcher would use the same colour to highlight. Teaching methods would become a concept, and other things related (types of teaching method: small teacher) would become categories. All would be highlighted the same colour. Use different coloured to highlights to distinguish each broad concept and category. Then transfer these into a brief outline, with concepts being main headings and categories being sub-headings.

Next, researcher chose to apply Colaizzi's (1978) conceptual analysis in this study. The steps involve:
Firstly, researcher decided upon the level of analysis, for example to code for a single word or sets of words or phrases. Secondly, researcher must decide how many different concepts to code for. This involves developing a pre-defined or interactive set of concepts and categories. Researcher coded not only from this pre-defined set but also allows to add relevant categories not included. Thirdly, researcher decided whether to code for existence or frequency of a concept. This is important because it changes the coding process. Fourthly, researcher decided on how he distinguished among the concepts. In addition, researcher must next decided on the level of generalization, i.e. whether concepts are to be coded exactly as they appeared, or if they can be recorded as the same even when they appeared in different forms.

Fifthly, researcher developed rules for coding the texts. After taking the generalization of concepts into consideration, researcher had to create translation rules that would allow him to streamline and organized the coding process so that he was coding for exactly what he wanted to code for. Developing a set of rules helps the researcher insure that he was coding things consistently throughout the text, in the same way every time. Seventhly, researcher decided what to do with 'irrelevant' information. Researcher must decide whether irrelevant information should be ignored (Weber, 1990), or used to re-examine and/or alter the coding scheme.

Eighthly, researcher coded the texts once these choices about irrelevant information are made. This is done by using computer programme. Once the coding is
done, researcher examined the data and attempted to draw whatever conclusions and
generalizations were possible. Of course, before these could be drawn, researcher must
decide what to do with the information in the text that was not coded. One's options
included either deleting or skipping over unwanted material, or viewing all information
as relevant and important and using it to re-examine, reassessed and perhaps even altered
his coding scheme.

Finally, the researcher would write a rich and comprehensive description of the
lived experience and from this the essential structure of the phenomena would be
formulated. Validation would be solicited from the information providers to compare the
researcher's descriptive results with their lived experiences. Triangulation from different
data sources were used to build a coherent justification for the themes. This description
will be presented in the findings section in Chapter 4.

The research matrix in Table 3.4 summaries the data collection method, the data
analysis method in relations to the research questions:
Table 3.4 Research Matrix

<table>
<thead>
<tr>
<th>Research Questions Method</th>
<th>Data Collection Method</th>
<th>Data</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent mathematics teachers’ competencies from the perspective of school principals?</td>
<td>In-depth interviews: a total of 5 CIHS principals</td>
<td></td>
<td>thematic analysis</td>
</tr>
<tr>
<td>To what extent mathematics teachers’ competencies from the perspective of senior assistants?</td>
<td>In-depth interviews: a total of 5 CIHS senior assistants</td>
<td></td>
<td>thematic analysis</td>
</tr>
<tr>
<td>To what extent mathematics teachers’ competencies from the perspective of the mathematics department heads?</td>
<td>In-depth interviews: a total of 5 CIHS mathematics department heads</td>
<td></td>
<td>thematic analysis</td>
</tr>
<tr>
<td>To what extent mathematics teachers’ competencies from the perspective of mathematics teachers?</td>
<td>Focus group interviews: a total of 13 CIHS mathematics teacher</td>
<td></td>
<td>thematic analysis</td>
</tr>
<tr>
<td>To what extent mathematics teachers’ competencies from the perspective of students?</td>
<td>Focus group interviews: a total of 27 CIHS senior secondary education students</td>
<td></td>
<td>thematic analysis</td>
</tr>
</tbody>
</table>

The thematic analysis was conducted in four stages as follows: (i) identification of coding template of the data; (ii) identification of the data set; (iii) analyzing of data, applying template of codes to data set, and (iv) examining the emerging challenging the ended themes.
3.9 Ethical Considerations

Researcher aware of the ethical issues inherent in educational research which is an essential part to be considered in research methodology (Langenbach, Vaughn & Aagaard, 1994). Basic ethical conduct covers the various aspects such as information providers' safety, confidentiality, informed consent, privacy, rapport, intrusiveness, etc. (Lichtman, 2010). The following considerations and measures were used to protect the information providers' rights:

(i) All the information providers had been advised in writing of the voluntary nature of their participation and that they could withdraw from the study at any time without penalty. They were also advised that at any time during the process they could refuse to answer any question.

(ii) The research objectives were clearly outlined in writing and communicated to the information providers.

(iii) Written transcriptions and interpretations of the data were made available to the information providers.

3.10 Conclusion

This chapter discusses and summarises the procedures employed by the researcher in conducting the study. In overall, the research design was distinctively elaborated from
the aspects of the methods, samplings and instruments. The strength and weaknesses of
the approach were discussed. Data collection and analysis methods were also tabulated
and stated. Procedures and pilot tests were explained. In the next chapter, the findings of
study would be explored to disclose the answers to the research questions. In conclusion,
the methodology of the study was very much to determine the findings of this study. It
was instrumental to allow researcher in obtaining authentic data and information.
CHAPTER 4

RESEARCH FINDINGS

4.1 Introduction

As indicated in Chapter 1 and Chapter 3, the objectives of the study were to investigate the teaching competencies in the areas of CK, PCK, PPK, organizational knowledge, and counselling knowledge from five different perspectives in the case study of CIHSs in Penang. The findings were derived from two different research methods, i.e. using in-depth interviews to the school principals, senior assistants, and mathematics department heads while focus group interviews to mathematics teachers and students to capture the interpretation of these five different perspectives about mathematics teachers' competencies in their teaching profession. A few themes and subsequently categories were formed from the labelling and coding of the data of both the focus group and in-depth interviews. Hence, this chapter presents the results and analysis of data mainly in accordance to the themes of qualitative data from the interviews in explaining the process and to what extent the mathematics teachers' competencies in their teaching profession.
4.2 Profiles of the Respondents

The five groups of respondents were selected based on purposive sampling and snow ball sampling methods and they had voluntarily agreed to allow interviews in the study. They were (i) five school principals, (ii) five senior assistants, (iii) five mathematics department heads, (iv) 13 mathematics teachers, and (v) 27 senior secondary students whose profiles were detailed below:

4.2.1 School principals

School principal in School A is indicated as P1 graduated from Universiti Sains Malaysia in social sciences, her major expertise is economic. After she graduated in year 1996, she started her career as a teacher in School A. She taught Malay Language and Form six Account subject. In year 1998, she became head department of Malay Language. After two year in 2000, she was promoted to be senior assistant. In year 2005, she was promoted to become acting principal, and the following year 2006, she became principal until now. She has 12 years of experience as school principal. At the initial stage, when she held principal position, School A had about 700 students and 60 teachers. The number of students was gradually increasing until today School A has about 1800 students with the number of teachers as 120.

School principal in School B is indicated as P2. He started his tertiary education in Universiti Malaya in 1971. His ambition was to become a teacher although he was rejected for three times, but he insisted to become a teacher. He possessed his bachelor
degree in the area of pure mathematics. He came from a poor family and his father had to sell his lorry to support him in his study. He managed to continue his undergraduate study with RM1500 from the money that he got from selling the lorry for two years tuition fee in Universiti Malaya. Fortunately, he got his scholarship after two years to finish his undergraduate study. Since he insisted to become a teacher, he continued his study in diploma of education. In order to fulfill the conditions of scholarship, he had to pay back his service for seven years. He started his teaching career in a national secondary school in Kulim for 10 years. After that he transferred to a national Chinese type secondary school in Perak for four years as a teacher. He was promoted as senior assistant in another national Chinese type secondary school located in Setiawan, Perak for a period of nine years. Later, he was promoted to be school principal and retired in year 2007. He started to hold the position as school principal in School B since year 2008.

School principal in School C is indicated as P3. He has already working in School C for more than 20 years. He has 12 years of experiences working as a school principal in School C. After he graduated from a local public university, he continued his study in United States in the area of entrepreneurship management. Over the past 20 years in School C, he started his career from a teacher, head of disciplinary board, senior assistant, until school principal. To his opinion, he found that being a principal needs management skills which was relevant to his academic background.
School principal in School D is indicated as P4. She has been working in School D since year 1997. She graduated from Univeristi Kebangsaan Malaysia, Sabah branch campus. Her specialization is biology. Before she studied in university, she had been a temporary teacher in School D. During that time, she started to love School D and had a very good relationship with her students. Once she graduated, the principal at that time was her teacher before and invited her to join School D. Although she had been a temporary teacher in Chinese type primary school and also national school but she liked CIHS very much. She liked the culture of CIHS which was focusing on human relationship education with students as the first priority concept. She found herself more suitable for CIHS culture as she managed well the students is sufficient to fulfill her job specification, which was not so much tied with the requirement and rigid regulations from Ministry of Education. From year 1997 to 2003, she was a teacher in School D. She was promoted to be acting principal in year 2003. The following year, she became principal until now. She has overall 20 years of working experiences and 14 years of administrative experiences in School D.

School principal in School E is indicated as P5. Previously, he involved as educator for more than 30 years in public national schools. He started his career as a teacher in Science School, Bukit Mertajam for eight years. After that, he was promoted as school administrator including senior assistant, acting principal and principal in four different public national schools. After he retired from a national Chinese type secondary
school in Penang as a principal, he was invited to be a lecturer in one of the Buddhism University in Thailand for a year before he joined the current position as principal in school E. He has been holding the current position for three years. Although his area of expertise is Biology, he has taught various subjects for the past 33 years of teaching experiences such as Chinese language, music, and drawing arts.

4.2.2 Senior assistant

Senior assistant in School A is indicated as SA1. She has obtained both her undergraduate and master degree from Taiwan University. She started to work in School A since year 2002. In year 2009, she continued her study in Taiwan Normal University until year 2012. A year before she further study in Taiwan, she has already been the senior assistant. Her total working years until now was six years as teachers and six years as senior assistant, giving a total of 12 years in School A. She was inspired by two teachers to become teacher. She was a national school student and never thought of becoming a teacher at that time until she was studying in university. She met a teacher who made her realized that being a teacher is not teaching only but can be a family member of a big family. Another teacher told her that he came here to teach was to share his experiences and contributed back to his alma mater. These two teachers made her changing her mind to involve herself in education.

Senior assistant in School B is indicated as SA2. She graduated from the field of education and her specialization is Malay Language from Universiti Malaya and she has
been teaching in School B for 11 years. Recently in January 2017, she was promoted to become senior assistant. She was very familiar and love School B very much.

Senior assistant in School C is indicated as SA3. He was graduated from the field of education and specialized in life skills subject civil engineering area. His position is related to student affair encompassing counselling, discipline, and student affairs. His main role is managing students’ behavior. He has worked in School C for 10 years. Before that he was a senior assistant in a national Chinese type primary school in Paya Terubong, Penang for 14 years. Then he left the school and joined School C.

Senior assistant in School D is indicated as SA4. She has taught in this school for 19 years already. She graduated from Universiti Sains Malaysia, in the area of commerce and specialized in book keeping. Initially, she taught book-keeping in School D. Since there was not enough teaching period for book keeping, she decided to teach mathematics because of her interest. Although mathematics subject is not her option but she loves mathematics very much. Now she is only teaching mathematics not teaching book keeping at all.

Senior assistant in School E is indicated as SA5. He graduated from Universiti Teknologi Malaysia. He worked in CIHS Kelantan for two years. After that he transferred to CIHS in Kuala Lumpur for two years to study his master degree study as well. After that he came back to Penang, School E for three years. Next, he went to CIHS in Port
Klang for one year plus, then to CIHS in Johor Bahru for one year plus. Finally, he came back to School E again by year 2012 and worked until now. All the while, he has been working in CIHSs for more than 10 years. He also involved in school administration in most of the CIHSs except the first school in Kelantan. In School E, principal is involved in leading roles and he is more in managing roles. Most of the positions of his career path are administrative leader. In School E, he has been working under five school principals’ administration.

4.2.3 Mathematics department head

Mathematics department head in School A is indicated as DH1. She has already giving her service in School A for 11 years. Before that, she worked as administrative leader. However, she left School A for a while because she was sick. Only until last year, she started to be head department in School A. She graduated from Universiti Putra Malaysia with her specialization in mathematics with education. After graduated, she decided not to accept the Ministry of Education offer to be allocated in national schools. This is because of her personality that quite conservative and she was afraid of going to East Malaysia. Moreover, she was not tied with any scholarship and her tuition fee was financially supported by her parents. Her education background was national Chinese type primary school and national secondary school using Malay language as medium of instruction. Throughout her career path, she just worked in CIHSs only. Her first school is CIHS in Sungai Petani for more than 10 years. Because of the low number of student in
CIHS Sungai Petani, she found that there was not much that she can learn. She transferred to a CIHS in Perak. This CIHS, Perak only have UEC syllabus, they did not have SPM. This CIHS Perak only used Mandarin as medium of instruction. After a few years, she thought of came back to north of Malaysia. She came back to Penang and applied for School C and School A. At the same day, she got the two offers one in the morning and one in the afternoon. Because of the offer from School C came first, she went to School C and worked for three years. She met the current principal of School A, at that time she was the acting principal of School A and asking for her help in School A. Because of School A has better opportunity for development, she agreed to join School A.

Mathematics department head in School B is indicated as DH2. He graduated from Taipei University and specialized in information engineering. He has been working here for seven years. At the beginning, he would like to work in School B but no vacancy at that time. So he was recruited by School C and worked for a year. The following year school B has vacancy for him, he straight away joined School B. The main reason he did not like to travel to Penang Island while he is staying in mainland and also School B is his alma mater.

Mathematics department head in School C is indicated as DH3. He graduated from Universiti Malaya in the area of chemical engineering and worked in a factory for nine years. In year 2009, he started his teaching profession. School C is his first school.
and he has taught in School C for nine years. At the beginning he taught science subject together with mathematics, now he is teaching mathematics only.

Mathematics department head in School D is indicated as DH4. Her elementary and secondary education was obtained from national Chinese type schools in Balik Pulau, Penang. After that, she did her Form Six in School C and continued her tertiary education in Universiti Utara Malaysia in the area of economic. After graduated she worked in private company dealing with foreign workers for a year, she applied to be teacher in School D by year 1999. She has 19 years of teaching experiences in School D. Although she is two years older than SA4, they joined the school at the same time. Her specialization is not mathematics but she is interested in mathematics very much. When she first joined School D, she was given to teach senior applied mathematics Year 1. At that time, she felt very stressful and she also taught commerce subject. She and SA4 got a lot of assistance from Professor Ong who taught in School D at that time as the head department of mathematics after she retired from Universiti Sains Malaysia. In School D there is no economic subject for her to teach, mathematics is one of the subjects that she is interested. So no matter how difficult, she has to make herself a success. The main reason she was recruited at that time mainly caused by School D suddenly increased the number of students from one hundred over become more than 600 students. This is because at that time there was turmoil happened in Indonesia, many students from Indonesia migrated to Malaysia to study. They are all Indonesian Chinese made up about
50 percent of the total student population. As a result, School D had to recruit teachers. Indonesian Chinese can speak hokkien and very emphasized on Mandarin. They can speak Malay Language too so language was not a big issue at that time. Although Indonesia government was not allowed them to study Mandarin, their parents sent them to private tuition to study Mandarin. That is why they liked to send their children to CIHSs in Malaysia.

Mathematics department head in School E is indicated as DH5. He studied in electrical engineering, worked in factory for six years. After that, he started his teaching career in School E for almost eight years by this coming June. DH5 continue his master study in teaching administration and the course is twining between Zhang Hua and New Era College but based in Johor.

4.2.4 Mathematics teachers

Mathematics teachers in School A are indicated as T1 to T3. T1 have been teaching in School A for 10 years already. She graduated from teaching profession New Era College. Currently, she is teaching senior secondary class. T2 is migrated from China, she has been teaching in School A for 7 years, and had completed her master degree in Universiti Sains Malaysia. T3 has been a teacher for 30 years, he is teaching physic and mathematics in School A. His expertise is in science and applied statistic. At the beginning, he was teaching STPM mathematics. After that he changed to teach in UEC
mathematics. Recently, he is teaching UEC and IGCSE mathematics in both Mandarin and English as medium of instruction.

Mathematics teachers in School B are indicated as T4 to T6. T4 graduated from Universiti Sains Malaysia. His specialization is major science education and minor in mathematics. He has been working in School B for four years already. Before that he worked in CIHS Chung Hwa Kuala Lumpur for two and a half year. T5’s expertise is chemistry and he graduated from University in Taiwan. He has been teaching in School B for 14 years. T6 specialized in Biology and he graduated from a university in Singapore. He has been teaching in School B for 11 years.

Mathematics teachers in School C are indicated as T7 to T9. T7 has already working in School C for 20 years. She felt that she has belonged to School C already. She is teaching junior secondary UEC mathematics. Although T7 graduated in mathematics option but she still found that what she learned from New Era College teaching professional training have helped her. In her opinion, teachers sometimes need refresh. T8 has been working in School C for nine years. She graduated from Universiti Putra Malaysia. Currently she is teaching senior secondary UEC general mathematics. T9 graduated from Universiti Malaya and has been working in School C for 11 years. Before that he was working in Chung Hwa, Kuala Lumpur for six years. He is teaching senior secondary UEC applied mathematics.
Only two mathematics teachers in School D and School E were involved in this study because these two CIHSs are considered as small sized schools. Therefore, there is limited number of mathematics teachers. Mathematics teachers in School D are indicated as T10 and T11. T10 has already taught in School D for 7 years. Her both degrees were obtained from Universiti Sains Malaysia. Her bachelor degree is material engineering and her master degree is in educational administration. She is teaching senior secondary UEC applied mathematics. T11 is a new teacher and has taught in School D for a year plus. She graduated from Universiti Malaysia Terengganu in the area of commercial mathematics. She is teaching junior and senior UEC general mathematics.

Mathematics teachers in School E are indicated as T12 and T13. T12 specialized in mechanical engineering. He worked in the factory for a while but found his interest is in teaching. Before that he taught in CIHS Chung Ling for two years, then only transfer to School E for a year plus. When he worked in factory, he gave private tuition. T13 studied in Rahman College Penang in computer science (diploma). Since 2010, he came to School E to teach, already 7 years. He is teaching junior and senior secondary UEC mathematics.

4.2.5 Senior education students

These 27 senior secondary students are comprised of S1 to S5 from School A, S6 to S10 from School B, S11 to S15 from School C, S16 to S20 from School D, and S21 to S27 from School E. S1 and S2 are from commerce class while S3 to S5 are from science class. All of them (S1 to S5) are in senior secondary Year 3. S1 to S3 joined School A
since junior secondary Year 1 while S4 and S5 were from national school transferred to School A when they were at junior secondary Year 2. S4 transferred to CIHS because of the implementation PT3 as new evaluation system in national schools. Her parents felt that she is not suitable with the national education system.

S6 to S10 are studying in School B senior secondary level but different level. S6 and S7 are in Senior Year 1, S8 and S9 are in Senior Year 2 and S10 is in Senior Year. S11 to S15 are studying in Senior Secondary Year 2 in School C. S11 transferred from national Chinese type school when she was in junior secondary Year 2 because of the higher standard of CIHSs compared to national schools. S12 to S15 started to study in School C since Junior Secondary Year 1.

S16 and S17 are studying in Senior Secondary Year 2 and they have two mathematics teachers who taught them in different topics using Mandarin as medium of instruction. S18, S19 and S20 are studying in Senior Secondary Year 3 in School D. A total of seven students joined in School E since Junior Year 1 except S22 who was transferred from School A since he was at Junior Secondary Year 3.

4.3 Mathematics in CIHSs

Mathematics subject in CIHSs is complicated because each CIHS has a few types of mathematics that schools offer in order to broaden the choices for their students. The UEC is a standardized test for all CIHSs organized by the UCSCAM since 1975. The
UEC is available in these five CIHSs in two levels: Junior Middle (UEC-JML) and Senior Middle (UEC-SML). The UEC-SML mathematics is available in Chinese and English. The UEC-SML is recognized as a qualification for entrance into many tertiary educational institutions around the world, including the United Kingdom, the United States, Taiwan, Hong Kong, China, Singapore, Australia, Canada and many others (Dong Zong Examination Bureau, 2012).

Because of UEC is not recognized by the Malaysian government, some CIHSs opt to teach the national secondary school curriculum (in English) alongside the independent school curriculum (in Chinese) and require students to sit for the government standardized tests such as SPM or even STPM as private school candidates, providing the students opportunities to obtain government-recognized certificates (Tan, 2015).

In addition, some CIHSs offer the International General Certificate of Secondary Education (IGCSE) to the students. IGCSE is an English language curriculum offered to students to prepare them for International Baccalaureate, A Level and BTEC Level 3 which is recommended for higher-tier students.

School A has two types of mathematics one is UEC and IGCSE (o-level) in English. The UEC programme is the main focus of School A and IGCSE programme just started six years ago. In regard to these two different programmes, administrators in School A have to depend on teacher competencies in planning their mathematics lessons and their proficiencies in either Chinese or English language to allocate the teachers
accordingly. In terms of teacher allocation in School A is quite complicated. School A has 48 classes and one third of the total numbers of teachers have to allocate for IGCSE. For example, Form 1 has five classes of UEC and four classes of IGCSE so school allocates two teachers in UEC programme as one experienced teacher and one new teacher. On top of that, school principal has to work closely with her senior assistant and head department to plan the teacher allocation so that the experienced teacher can be the mentor for the new teacher.

School B follows the Dong Zong track whereby there is only one instruction medium that is Mandarin. However, starting from last year Senior Secondary Year 1, School B has two classes of pure science, each pure science class using English and Mandarin respectively. Most of the good students chose the English medium class. Currently, this English group is at Senior Secondary Year 2 so their performance still unknown yet. By next year, School B will know whether there is a difference between English and Chinese language class in terms of their performance in UEC examination. According to P2’s personal principle, students should be taught in their mother tongue. This is because they can understand better if using their mother tongue. He himself not agreed with teaching science and mathematics in English because students once understand the concept well by using mother tongue, then change to other language such as English is not a problem anymore. Due to the change of public demand, P2 have to try to change his own principle by using English as medium of instruction to one pure science class started from last year.
School C provides two types of mathematics UEC and IGCSE. UEC mathematics teachers have to allocate into junior and senior UEC programme, about 10 mathematics teachers. School C has only one IGCSE class and seven UEC classes. Out of the seven UEC classes, two classes are science stream, and the others are four commerce and one literature and drawing art combination stream.

School D and School E are small sized schools. Therefore, these two schools cater for two types of mathematics UEC and government standardized tests such as SPM or even STPM.

4.4 Thematic Analysis on the Five Areas of Mathematics Teachers’ Competence

Researcher used thematic analysis to analyze the interviews data. Thematic analysis is a method of identifying, analyzing, and reporting patterns or themes within the qualitative data (Braun & Clarke, 2006: 79). Researcher utilized two distinct processes in this study: (i) a deductive process whereby the data were analyzed and interpreted using the templates from the theoretical background and the process is theory driven and (ii) an inductive process whereby a possibility for the data to contribute to the reformulation of some aspects of the theoretical framework was considered and this process is data-driven. Researcher followed the four stages as represented in Table 4.1 below to form the general scheme to analyze the qualitative data in the deductive-inductive process. These four stages of analyzing method was recommended by Fereday and Muir-Cochrane (2006).
<table>
<thead>
<tr>
<th>Stage</th>
<th>Steps in thematic analysis</th>
<th>Application of the steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Identification of coding template</td>
<td>Literature review and clarification of the theoretical framework of mathematics teachers’ competencies, especially on each domain of knowledge characteristics.</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Identification of the data set</td>
<td>Description and establishment of the background of informants.</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Analyzing of the data, applying template of codes to the data set.</td>
<td>Identification of the conceptual and lexical equivalents of characteristics in the data set, paying special attention to different setting of CIHSs.</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Examining the emerging themes (Verifying or challenging the coded themes)</td>
<td>Further exploration of the conceptual and lexical equivalents by the use of other theoretical sources, in an attempt to understand them, and considering their possible contribution to the theoretical framework of COACTIV.</td>
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</tbody>
</table>

Based on the analyzing steps in Table 4.1, the following findings were presented according to the research objectives in Chapter 1. Researcher had carried 15 cycles of in-depth interviews with five school principals (P1 to P5), five senior assistants (SA1 to SA5), and five mathematics department heads (DH1 to DH5) to obtain their points of view that related to their mathematics teachers’ competencies in five major areas namely CK, PCK, PPK, organizational knowledge, and counselling knowledge. Besides, researcher also carried out a total of 10 cycles of focus group interviews with 13 mathematics teachers (T1 to T13) and 27 senior secondary students respectively to triangulate obtained data.
4.5 Content Knowledge of Mathematic Teachers from the Perspectives of School Principals, Senior Assistants, Mathematics Department Heads, Mathematics Teachers, and Students

After a thematic analysis of the five principals, five senior assistants, five mathematics department heads, and 13 mathematics teachers’ transcripts, six themes about what constitutes to mathematics teachers’ CK were identified. These six themes were derived from two main coverage of CK being investigated namely teaching related aspects and learning process-related aspects. Teaching related aspects including curriculum and lesson planning while learning process-related aspects focusing on teachers’ actual instructional practice. The six themes were criteria of recruitment, high standard of UEC, classroom observation, insufficiency in CK of new mathematics teachers, lesson plan preparation, and various methods of assessment. Table 4.2 summarizes these six themes and the composition of each participant’s views. However, the 27 senior secondary students’ transcripts were not analyzed according to the themes but looked into their views about the mathematics teachers’ CK holistically.

Findings showed that almost all the respondents admitted that the high standard of the UEC examination is one of the major problems to cause the insufficiency in CK among the new teachers. The situation becomes even worse if the mathematics teachers are not from mathematics option. All the direct leaders of the mathematics teachers agreed that lesson plan preparation is an important mechanism other than classroom observation to assess the sufficiency of their mathematics teachers’ CK competency level. Only three principals stated that they should use various methods to assess their mathematics teachers’ CK. Although majority of mathematics teachers’ direct leaders
highlighted the issues of insufficiency in CK of new teachers but they themselves never agree that they are lacking of CK even though some respondents are new teachers.

**Table 4.2 Participants’ view about what constitutes CK of mathematics teachers**

<table>
<thead>
<tr>
<th>Themes of CK</th>
<th>Criteria of recruitment</th>
<th>High standard of UEC</th>
<th>Classroom observation</th>
<th>Insufficiency in CK of new teachers</th>
<th>Lesson plan preparation</th>
<th>Various methods of assessment</th>
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Notes: P – Principal; SA – Senior assistant; DH – Mathematics department head; T – Mathematics teacher

**4.5.1 Criteria of recruitment**

**4.5.1 (a) Principals’ perspective**

All the five principals emphasized that criteria of recruitment is a major factor that affecting mathematics teachers’ CK. According to their responses, mathematics teachers’ academic backgrounds determine their sufficiency of CK to carry out their
instruction in classroom. In order to make sure that mathematics teachers have sufficient CK, the recruitment criteria should be their major concern. Therefore, majority of the principals tried to recruit those teachers who have academic backgrounds in the area of pure mathematics, mathematics education or related to mathematics. The second choice will be those from science specialization like physics or engineering.

The five principals mentioned that they are facing shortage of qualified applicants to fill up the mathematics teachers’ vacancies making them to look for those applicants’ academic qualifications are in the areas of science or applied science or even those applicants from science stream while they were in high schools will be recruited. The five principals found that only these areas of teachers have sufficient CK to cope to their teaching. As a result, they are very particular on the criteria of recruitment to ensure those mathematics teachers have content knowledge of mathematical facts, concepts, procedures, and relationships among them. Most of the science graduates not interested to be teachers compared to arts graduates because of CIHSs cannot support them with high salary and also they have better working opportunities. The following verbatim interview records reflecting the principals’ actions to ensure their mathematics teachers have sufficient CK.

“All the mathematic teachers that I recruited must fulfill the criteria of their academic background such as in the area of pure mathematics, mathematics education or related to mathematics. I have difficulties to employ science stream teachers compared to art stream teachers. Most of the science graduates are not interested in teaching compared to arts graduates like language, history and so on. They have more opportunities and got more pay in other career” (P5)
“I have about more than 10 maths teachers. Most of the maths teachers are option math. If not, they also from science stream.” (P2)

“In my school we have 16 math teachers including the head department. When I appointed the head department I must ensure that she must have expertise which is directly related to math. That is why I choose this head department because she was graduated from UPM with her expertise in math. With that, she is able to plan and lead her team very well even though some of the math teachers are from science or commerce, because these groups of teachers still study math as core subject.” (P1)

“However, after we start IGCSE, we have recruited some new teachers. For example this teacher A is already six years in this school so far I let her teach maths in English because when we recruited her is based on her expertise in teaching maths in English.” (P1)

Most of the mathematics teachers in my school do not have teaching qualification specifically in maths. This is because in CIHS very difficult to get those teachers with the maths specialization. Normally when I interviewed for math teachers, I have to take into consideration about their SPM and STPM. Once they are from science stream normally they know the content and can teach well. My expectations to math teachers are high because I am a science stream student.” (P4)

“Most of the maths teachers’ academic qualification is in math if not, they are from science stream. When I interviewed them for recruitment, I tried to get those teachers whose options are in math to become math teachers. Every form has 2 classes of science stream.” (P3)

“I have only one class who learn math in English medium. I have to make sure that the teacher must have sufficient knowledge not only good in math but also his English language especially the English terminology. When I recruited him to be teacher, I have already confirmed him to be teacher in this particular English version class. He graduated from local public university and he said in university, they were taught math in English, then he should be no problem. I also get some feedback from students. For example, I gave a lift to one of my Korean student every day. He stays nearby my house. The Korean student gave a positive feedback regarding his math teachers’ ability in teaching math in English and his content knowledge competencies.” (P2)
4.5.1 (b) Mathematics department heads’ perspective

The above results from the five principals have been triangulated with the mathematics department heads. According to the five mathematics department heads, those mathematics teachers who are not optioned in mathematics and just interested in mathematics subject causing serious problems in their CK. Therefore, only those mathematics teachers who are experienced and specialized in mathematics will be allowed to teach senior secondary education class after considering about the sufficiency of their CK. This theme is derived from the following verbatim interview records:

“In School A, most of the math teachers are not from math option. Just like some teacher their option is not math for example drawing art but they just interested in math. We will give them one class to teach because we are shortage of math teacher. Or they are science teacher but like to teach math. When we interviewed new teachers, the same criteria we set for recruitment. When they met problems that they cannot solve, they will come to see us. Turnover rate is quite high in School A. This year we have four new teachers. Some old and new teachers left the school has caused the turnover. Because of majority of the math teachers are not major in math, some are major in science, some don’t even major in science but they said that they like math and their math in high school is not bad. They thought math is an easy subject to teach. These are the teachers who will face difficulty in their content knowledge while they are teaching math. Because of teaching math is not as simple as what they thought.” (DH1)

“Although I am not option in education, but the content knowledge from my engineering program is sufficient for me to teach the students.” (DH3)

“Three out of 12 teachers are specialized in math and they are teaching senior secondary. These 3 teachers are 10 years, three years, and one year experience. They are good in their CK.” (DH4)
4.5.1 (c) Mathematics teachers’ perspective

Mathematics teachers who are not specialized in mathematics field found difficulty to translate the CK into their lesson plans. However, CK from science or applied science teachers still found to relevance to mathematics contents.

“Actually the content of math that I have learned from engineering courses not much different is just the language difference. Language difference makes me quite challenging while teaching.” (T10)

“Although math is not my option but when I study the computer science program, I learned about programming which is high emphasizing in math subject. So to me there is no problem about the content knowledge. For example algebra, calculus was the topics covered when I was doing my tertiary education. I like math very much, during high school, I always like to do math, you know...lah, Chinese school student normally do not have problem. However, the content of ‘sine cosine and tangent’ is the topic that most of the students have problems.” (T12)

4.5.2. High standard of UEC

4.5.2 (a) Principals’ perspective

Through the analysis, the study also found that mathematics teacher CK is very important for mathematics teachers because they must prepare CIHS students to develop a very high standard of mathematical proficiency in order to cope with the high standards of UEC. Therefore mathematics teachers must have clear vision of the goals of their instructions. All the five principals agreed that CK of mathematics teachers is extremely important because mathematics is a difficult and important subject. The high standards of applied mathematics in UEC needs higher competency teachers particularly their CK. The
CK competency means their proficiency for the specific mathematical content that they are teaching. The following are the verbatim interview data:

“On top of that, the content knowledge in science stream subjects in UEC are particularly more difficult and higher standard compared to other public examination such as O-level or SPM and even equivalent with or slightly higher than A level or STPM. Therefore to recruit the qualified and competency mathematics and science teachers are important due to the higher standard of UEC examination. Since I graduated in the areas of biology and mathematics, considered as an expert from public university also found insufficient competency to handle the applied mathematic subject in UEC. The mathematic standards in UEC follow the mathematic standards from China and Taiwan which are very much higher than the mathematic standards of Malaysia.” (P5)

“If those students who gained good result in mathematics of UEC are confirmed to be excellent students while those national school students who scored good result in mathematic cannot be sure that they are really excellent in mathematic yet.” (P5)

“Applied math of UEC is very difficult. Recently there is a change of exam format. What we do is teachers will communicate among each other and they have to aware of the change to prepare their students.” (P2)

“Maths is a very difficult subject to our students because most of students are moderate students so it is quite hard for them to cope to the difficulty in the math subject.” (P2)

“Students are found hard to mastering math skills. That is why we have advised and set the pre-requisite to our students that they must pass their math, the passing mark is 60%. (P2)

“Many of the students are lacking of interest in math because of the high standards of difficulty, principals and teachers have to advise and motivate them to study math from time to time. The major problem is more on students’ initiative to study math than teachers’ abilities to teach them. Students should be more proactive and independent while they are learning math. Some of the students give up this subject
they just copied the answers without understanding. A lot of efforts have been put in to encourage students to do their homework and assignments, some students seem to be changed but still there is a few of students still failed to change their attitudes in learning math.” (P5)

“Math subject is very difficult, their relationship with students will become very important. If students are scared of the teachers, once he cannot solve the math problem, he will first seek help from their friends, after that he will find his teacher to help. So the relationship between them is important.” (P3)

“Most of the students resigned from their study because of too high standards of UEC exam.” (P5)

“Many of the students cannot cope with the high standard of UEC. After the mid-term exam, we will see whether some students need to change to commerce class or need to give them extra class to improve them.” (P1).

4.5.2 (b) Senior assistants’ perspective

Majority of the senior assistants are very satisfied and confident with their mathematics teachers’ performance in regard to their CK. Besides, they stated that most of the mathematics teachers in their CIHSs are experienced teachers and have a very high team work spirit to help the students. They also believed that most of the mathematics teachers know very well about their subject matter and have reached a certain level of understanding of the subject matter then only they are allowed to teach the high standards of UEC mathematics. The following verbatim interview records were supported the above analysis.

“Content knowledge of our math teachers is sufficient because all of them always discussed among themselves. They also created some extra questions to train
students. After creating the questions according to each topic, they will accumulate all the questions and published as an exercise book for all the levels. We called this book as 'add in petrol station' (SA2).

“But through our meeting, the high expectation from school to science and math which we determined 60 percent as the passing marks, set it very high, so the content knowledge of our teachers definitely must not an issue anymore. They must have high CK or else they will not be smarter than students” (SA5)

“We are a small sized school, added with student quality is not so good but we can see the teachers’ efforts is something that we cannot denied that the overall results are quite stable though the focus of parents, student quality and expectation are changing from time to time, yet they can remain the stable results. I am very confidence with these two teachers’ about their content knowledge, UEC exam format, techniques of answering the UEC exam questions, their teaching method and so on.” (SA5)

4.5.2 (c) Mathematics department heads’ perspective

In general, most of mathematics department heads stated that there are too many types of different mathematics examinations in CIHSs such as UEC (Mandarin), UEC (English), IGCSE, and SPM ultimately creating a complicated situation for them to allocate their mathematics teachers in order to match their CK and language as well. If mathematics teachers have sufficient CK to prepare students for UEC examination, the other examinations should not be a problem. However, majority of the mathematics department heads revealed that the major problem in other examinations is not the CK but the language difference. Mathematics teachers have to do a lot of translation between the three languages namely English, Mandarin, and Malay languages. This issue is presented as follow:
“In School A, I have 15 team members and distributed them into either junior or senior high school classes. We are not distributed them clearly. Some teachers still have to teach both levels. We have many types of math in School A: Math in English UEC, Math in Mandarin UEC, Math in O-level, and Math in IGCSE. So teachers teach using the medium of instruction based on what we have identified as this class is using Mandarin or English to teach. As a result, students will be allocated into their class according to the types of math. However math in O-level math or so called as SPM, the standard is lower than UEC level. For example, UEC Junior Year 1 syllabus covers some topics in Form 4 at national school. Some topics in UEC Year 3 reached the level of STPM. So UEC exam is very much harder compared to others. (DH1)

“For those teachers choose English, we also look into their English proficiency level before decided to require them to teach in English class.” (DH2)

“So teachers’ content knowledge sufficient for three languages in math is questionable, actually is not enough. Like me as a student graduated from CIHS, I had not sufficient capacities to teach SPM. So normally we will choose those teachers who are graduated from local public university or the teachers themselves have been studied math in Malay language to teach. Besides, most of them have been taken SPM before.” (DH2)

“Basically the content knowledge of my high school education is still sufficient for me to teach. Of course last time I study math in Malay language, when I came here I have to translate to Mandarin. I was from National Chinese type high school, I need sometimes to adapt to the language difference. Some of the content knowledge, I learned up after I started teaching in School E.” (DH5)

4.5.2 (d) Mathematics teachers’ perspective

Majority of the mathematics teachers agreed that the senior UEC mathematics too difficult for the students to understand although they have sufficient CK. They stated that UEC standard is higher than most of the public examinations such as A-level, STPM,
matriculation, and SPM. Topics like trigonometry and geometry or 3D topics are the topics that generally students cannot perform well. They have sufficient CK to teach but most of students cannot understand unless they are really smart.

“The level of difficulty in senior UEC exam, I can put in this way. The applied math for Paper 1 is more difficult than SPM and the Paper 2 is more difficult than STPM about 60%.” (T3)

“Senior secondary UEC have to cover two levels including SPM and STPM thus more difficult than matriculation. So when students in Year 1 for certain topic they have already studied the same topic until STPM level already. So it is very difficult for students. Some topic they have studied in Year 1 like Trigonometry. Then Year 2 they did not study at all, so they have already forgotten when come to Year 3. UEC is very difficult because we are making the two exams SPM and STPM into one exam, from 4 years to 3 years. This is very challenging.” (T4)

“Personally, I found that it is related to the toy that we play. Last time, students play more on concrete things, now students just play computer games which are considered as visual only. So this kind of topic which needs them to think something abstract, they cannot do it.” (T4)

“Applied math in UEC the difficulty of exam questions too high level compared to the questions in text book. Sometimes the questions not included in the text book also can be appeared in the exam. Students can do more than half considered as very good already.” (T6)

“Math is my option so the content knowledge is not a problem to me. However, I was from national school. At my schooling time I learned math in English and now I have to teach math in Mandarin. I found the UEC math is very much higher standard compared to national school math, UEC math is at STPM level.” (T11)

“At first I taught in junior UEC which I found the content is not so difficult but later I was teaching senior secondary UEC applied math, I have to do a lot of preparation. Because of my schooling time, I learned math in Malay language,
some math terminology have to translate from Malay to Mandarin. The colleagues here help me a lot.” (T10).

4.5.3 Classroom observation

4.5.3 (a) Principals’ perspective

Majority of the principals have used classroom observation as a method to assess the mathematics teachers’ CK competencies. All the principals have carried out their classroom observation for the new teachers in particular to ensure they have sufficient CK. Generally, classroom observation will be carried out two times per semester. The following verbatim interview data showed that most of the principals are quite confident with the senior mathematics teachers and they are not doing classroom observation to check on their CK competencies.

“Most of the math teachers do not have problems in their content knowledge. The new teachers we will observe them for two times a year. Unless some teachers who have received parents’ complain, we will observe more than two times. We also will talk to the teachers if we found that they are having problems in their teaching especially those who have taught the wrong mathematical concept.” (P2)

“Only the new teachers will be observed by head department, senior assistant. The experienced teachers we did not observe them. Normally they will be observed by principal, senior assistant or head department.” (P2)

“Classroom observation will be scheduled at the beginning of the academic year and each teacher will be observed two times per year. In order to have better performance, teachers are informed when they are being observed by school administrators.” (P5)
“New teachers need to observe by us to ensure they have sufficient content knowledge to conduct their class.” (P3).

“Classroom observation will be carried out to those new teachers two times a year.” (P1)

“Normally new teachers will be observed at least 2 times a year, some more than that.” (P3)

4.5.3 (b) Senior assistants’ perspective

Majority of the senior assistants’ views seemed to be contradicted with principals’ views. They did not believe that classroom observation can be a way to know about mathematics teachers’ CK. This is because mathematics teachers have been informed before they are being observed. They would rather believe on lesson plans, management by walking around, students’ feedback, students’ homework performance, and new teachers observe the experienced teachers and learn from that. The following verbatim interview records show the findings:

“Classroom observation is not an accurate measurement on teacher’s teaching because teacher was informed before we observed. So the lesson plan is definitely fixed the implementation of teaching. However, we always management by walking around, that will be more accurate to know teacher’s CK. In our system, teachers still cannot accept that we observed them teaching without informing them. But if we received complain from students, I will walk in to observe her teaching.” (SA 1)

“We have two types of classroom observation, one is experienced teacher observe new teachers, giving comments to help them and another type is new teacher observe the experienced teacher’s teaching so that they can learned from them. Lesson plans we worked together and teach based on the lesson plan. I felt that the second type is more effective than the first type. I find that the first type is not so
effective because if you just tell them, some new teachers may not clear about what you mean. So normally when the new teacher comes to observe me, I will show to her how to improve her weaknesses that I meant before. They will learn better than and understand well.” (SA4)

“So if I want to know about teachers’ CK, I will focus more on students’ homework, exercise, assessment through checking students’ works and also through meeting with them. Classroom observation is just a formality and does not give us much information about their competencies.” (SA5)

4.5.3 (c) Mathematics department heads’ perspective

Most of the mathematics department heads were slightly disagreed that CK of a mathematics teacher can be identified through classroom observation. They just did the classroom observation to new teachers and felt that there was not beneficial much. The following verbatim interview records reflecting their comments:

“Because of time constraint, school has fixed the months for us to do observation, particularly to the new teachers. For example I have new teachers this year, by January 2017, I have started my observation already. For example I as head department will be observed by principal and senior assistant 2 times a year. But for new teachers, the numbers of observation are not fixed. For example those teachers who received negative feedback from students, other than face-to-face discussing on the problem, I have to do the classroom observations. We need to know whether the problems are from the teachers or from the students.” (DH1)

“I have 16 team members. Because of that, I only observed the teacher for one period, not much ability that I can observe.” (DH2)
4.5.4 Insufficiency in CK of new mathematics teachers

4.5.4 (a) Principals’ perspective

Generally, all the principals are not confident with new teachers’ CK. Majority of the new teachers are found to be insufficient in their CK. According to most of the principals, these new teachers are required to develop by their peers or send for training.

“During our school professional learning meeting, those experienced teachers will teach those teachers who are lack of experiences on how to teach for some difficult topics. They even discuss about what types of questions will arise and how to answer those types of questions.” (P4)

“Why I did not let the new teacher to continue to teach the same class because I find that she is not capable in teaching the one that has least experience that you interviewed her just now. Then I worry that her lacking of content knowledge although she has her math academic background yet she will destroy my students. The new teacher I let her teach the same subject as last year so that she is familiar with the content and this year, she seems to be better and more stable. We need 2 to 3 years length of time to train a new teacher to be competent.” (P4)

“The three teachers that you interviewed just now as the first one is a new teacher has math background but the second and third teachers are experienced teacher who have no math background. But they are not much different at the beginning stage. This is because upper secondary class I do not let those lack of experience teachers to teach even not possible for those who are not her options. However those although not option in math but they are option in science still better than those lack of experiences but math is her option.” (P4)

“Content knowledge is sufficient for those teachers who are teaching senior secondary class because only experienced teachers are allowed to teach senior secondary. Those new teachers, I will let them teach lower secondary.” (P3)
“Normally, new teachers will have to go for training for about 2 to 3 months. In this school, they have a mentor to guide and help them, they also have meeting every week. Normally new teachers will raise their problems during the meeting and experienced teachers will try to help them.” (P3)

“Those new teachers are found to be insufficient of content knowledge to teach mathematic in CIHS unless they are formerly CIHS students. Those new teachers who are graduated from public national schools have to study hard based on the textbook by referring to the guidelines provided by Dong Zong then only are able to cope with the higher standards or else they will teach the wrong mathematical concepts. Most of them have to do their own justification especially those new teachers who lack of strong mathematical content knowledge foundation although their academic background is related to math. Some new teachers have to struggle a lot to understand the content knowledge before they can teach well in the classroom. They need to struggle for a few years before they obtain sufficient content knowledge through their daily teaching experience.” (P5)

4.5.4 (b) Senior assistants’ perspective

All the senior assistants agreed that new teachers are insufficient in their CK. Many of them utilize peer-assistance mentoring method to help the new teachers to develop their CK. For example, they encouraged the experienced teachers to guide the new teachers through classroom observation, regular meetings, and professional learning community practices. The following verbatim interview records show the identified theme:

“Most of the math teachers in School B are experienced teachers. This year, we have 2 to 3 new teachers. When we recruited a new teacher, administrators will communicate with head department to assist the new teachers. After that, administrators will observe the new teachers’ teaching. Besides, we also arrange this new teacher to observe other experienced teacher teaching at least 3 times. Our philosophy is we are growing together with them.” (SA2)
“We also have every form meeting whereby the same form level teachers will have meeting. All the while, we are trying to guide the new teachers gradually. Students in school time is quite long from 7:30 to 4:00 p.m. so experienced teachers have to lead and guide the new teachers.” (SA2)

“We have this type of meeting every week. During this professional learning community, the experienced teachers will help the new teachers in all aspects including students’ problems, content of maths, how to teach and so on. This weekly professional learning community activity has been started three years already.” (SA4)

“Out of the three teachers that you interviewed just now, they are very experienced teachers including the head department and the teacher who taught Senior Year 3. Teachers who teach Senior Year 3 are mostly experienced teachers. I understood their working styles quite well.” (SA5)

4.5.4 (c)  Mathematics department heads’ perspective

Generally, the mathematics department heads are having the same views with principals and senior assistants related to new teachers are insufficient in their CK. However, only School C department head agreed that his school has a comprehensive way to develop new teachers’ CK that is mentor-mentee system and two years informal observations. The insufficient CK partly is because of the high standards of UEC and various types of mathematics public examinations that causing the new teachers even hard to cope with it.

“Content knowledge for those experienced teachers, most of them had mastered the content knowledge quite well. Their experience also built on their strong math conceptual foundation as well as their teaching idea or philosophy. But for those new teachers they have the problems in content knowledge.” (DH1)
“Actually School C has a comprehensive method to develop new teachers. For example, they have to go through two years observation. I will go to their class to observe them teaching, 2 times per year for 2 years. Previous year the school has a method of mentor-mentee system whereby the new teacher will be provided an experience teacher to become his mentor. If they have any problem, they will refer to their mentor. But now, the mentor-mentee system was already not practicing anymore. So new teachers have any problems will refer to me for solutions.” (DH3)

“For senior secondary Year 1 and Year 2 I still ok is about the same as SPM but when come to Year 3, I find difficult because it is like STPM. For teacher just newly involved I found quite difficult for them to handle.” (DH3)

“When the new teachers start to join my team, I always taught them from my own experience, that is they must understand their students. Teacher can think that he is very strong, and use the method that he thinks is good. This is because it is not necessary suit for students. New teachers must give homework exercise in order to know students’ level. From the students’ responses then only teacher can prepare the lesson suit the students. If the students showed to teacher that they are already expert in this topic, then teacher should upgrade the level of difficulty. If students’ reaction shows that they cannot cope with it, then teacher has to reverse back to the previous topic and teach them again. It is no point for teacher to continue in this case.” (DH4)

4.5.4 (d) Mathematics teachers’ perspective

All the mathematics teachers agreed that they are always helping each other especially to new teachers including setting questions, teaching methods, and solving students’ problems related to their understanding on the content of mathematics. All the five CIHSs have a very close relationship among their colleagues for sharing their experiences.

“Every week we have math team meeting. During the meeting senior teacher will help the new teachers regarding setting suitable questions to students, teaching method. We have a lot of sharing including the lesson plan. We checked among
ourselves about the progress. I find this is effective. So we will alert whether we are too fast or not. “(T7)

4.5.5 Lesson plans preparation

4.5.5 (a) Principals’ perspective

Findings revealed that all the five school principals evaluated their mathematics teachers’ competencies related to content knowledge based on their lesson plans preparation. They also have a regular system to check mathematics teachers’ teaching quality through lesson plans. They are satisfied with the CK implementation which had been shown in their lesson plans. The following are verbatim interview records:

“My school has started the professional learning community activity like all the math teachers at the same form preparing the lesson plans together.” (P4)

“All the teachers have to pass up their lesson plan every week and the head department will check.” (P2)

“I would like to mention about how to plan our lesson plan. My head department has to do research and works with her team thus produce this book which covers all the lesson plans throughout the year for every form. By examining the exam question in UEC and IGCSE, carried out some research, discussion with the whole math team, then only they can produce a guidelines book covers both UEC and IGCSE for all the math teachers to follow. They have identified with yearly lesson plan and weekly lesson plan for both different medium of math classes.” (P1)

“Teachers have to teach according to the format as proposed by ministry of education, for example cover content, objectives, teaching method, teaching aids and so on.” (P1)
“The whole year lesson plan we do it together there is one week before the school starts at the beginning of the year. Immediately after Christmas that is on the 26th Dec we have two days meeting after that it is followed by small subject team meeting. Then all the math teachers by referring to the guidelines book and set up the lesson plan for the particular year. My head department is very capable, she divided her group into each form, every form she selects a team leader to design the whole year lesson plan, once there is a change in syllabus like last year applied math for senior UEC has changed, she has to be alert and make the necessary amendments in the yearly lesson plan as well as in the guidelines book. Even the visitor from ministry was impressed with what we have done because their planning is really comprehensive.” (P1)

“Head department is responsible to check the lesson plan. I only look into those problematic teachers. Normally head department or senior assistant will report to me if they found some problems. Then I will meet up with the teachers and solve the problems by using face-to-face to the teachers.” (P3)

“Previously all the lesson plans from all the 25 teachers in this school were checked by the two school administrators namely principal and senior assistant. However started from this year, the lesson plans of math teachers will be checked by the head of math department weekly while principal and senior assistant will check the lesson plan every month. This is totally different from national school administration. When I was the principal in national school, I just checked the lesson plans of the head departments only not all the teachers.” (P5)

“When there is a scheduled classroom observation, teachers will prepare a detail lesson plan which is totally different with the brief lesson plans that they submit to head departments weekly. Most of the teachers are quite stressed while they are being observed.” (P5)

4.5.5 (b) Senior assistants’ perspective

Majority of the senior assistants found that most of the mathematics teachers are able to write a comprehensive lesson plans and follow the lesson plans closely while they are conducting their instructions. However, they still need a consistent monitoring system
to track the progress of the lesson implementation. This is because all the CIHSs have four summative evaluations which enquire the progress of the lesson for the same form should be at the same speed. The following verbatim interview records show the theme:

“Majority of the teachers in this school can write a complete lesson plan. So far I just met with one teacher who always wrote lesson plan not the same as what she did in the class. This is because we have checking her students’ work and found that they were not matched with the lesson plans. Besides, School A has a lesson report which must be filled by either monitor or secretary of the class. The report will be stated what they have learned from each lesson. All the lesson reports will be sent to me for checking. From these reports, I will notice the progress of the lessons. If I find that any of the teachers did not follow the milestones that the team set, because students are going to have the same exam which covers a number of topics, so I will discuss with head department if this matter happened.” (SA1)

“Our relationships with teachers are quite close. At the beginning of the year, math teachers at the same form will discuss and plan the whole year plan. Teachers have to write their daily lesson plan and submit to principal for checking.” (SA2)

“Teachers are writing simplify lesson plan not the detail lesson plan because they have the yearly plan already. So we did not request them to have the detail lesson plan.” (SA2)

“We have UEC and SPM exams. At the beginning of the year, we have curriculum planning. We put the focus on UEC exam, most of the topic will be same, just sequence not the same. For example UEC Topic 1 will be the same as Topic 4 in SPM, we put the same contents together and teach. Normally, the same topic of UEC questions more difficult, so if students can do UEC questions, SPM questions are no longer a problem. We just add some questions in English only for preparing students to attend SPM. Language different is not an issue for math because math is symbol, not like science subject, may be language different will be problem between UEC and SPM.” (SA4)

“Lesson plan will be checked by head department, principal and myself. I will check 6 times per semester. Besides, we have progressing report and evaluation record as
well as students' feedback can be used to know about our teachers' CK. Normally we will check on the number of questions, times of evaluation, how many percentage of students can pass, why many students cannot pass, are the questions too hard for them, relate the normal exercise with the given assessment, all these are our benchmarks. Based on this, I have to discuss with the teachers if I found some problems about teachers’ CK through my checking. (SA5)

4.5.5 (c) Mathematics department heads’ perspective

All the mathematic department heads pointed out that they are having problems to convert their CK to the lesson plans. This is because they are lacking of reference and resources to match their lesson to various different types of examination. Some of the department heads pointed out that their mathematics teachers are not creative enough to translate their CK into lesson plans.

“All lesson plans of math teachers are checked by me every week. To my opinion, the lesson plans preparation in School A still need a lot of improvement. If for me, we have to write in details covering objectives, method of teaching, what exercise that teacher gives have to list up, finally students have to do reflection. All these are not in our teachers’ lesson plans. Because teachers must know what they are going to teach.” (DH1)

“I check their lesson plan, if sub-topic repeating in their lesson plan I will question them. After checked by head department, then checked by principal. Principal has to check all the lesson plans for all the teachers in School A.” (DH1)

“I did not check their lesson plan, their lesson plans only checked by principal and senior assistant only. Yearly lesson plan has been prepared ahead of time. For example, this year 2017, we have already informed what class we will teach in 2018, who will be responsible to prepare the yearly plan. When come to that time, let say beginning of year 2018, there are 3 teachers who teach the same form, they will discuss again with the yearly lesson plan. Just like last year because of flood, the yearly lesson plan has to adjust because school was started one week later, so the yearly lesson plan has to change accordingly.” (DH2)
“Only head department will observe the new teacher, do not have any administrators to observe them. Normally when I observe, I will look into their lesson plans, see how they transfer their knowledge, how they communicate content knowledge to students.” (DH3)

“References are limited. Moreover some references from Dong Zong are in mandarin, we have to teach in two medium, Mandarin and English. Usually I will use STPM reference while I am preparing my lesson plan. Sometimes I have to share the content from national school.” (DH3)

“When I observed my teacher teaching, they are no difference between what they have written in the lesson plan and what they are implementing in the class. They followed what they planned tightly. What I am not satisfied is teachers are not creative enough to plan their lesson. I also understand that normally when teacher under observation, they will do better than normal, also not creative. Definitely, not being observed that time, even worse than what I observe.” (DH3)

“We plan our lesson by ourselves, we did not follow the guidelines given by Dong Zong. Because of our students are taking SPM, some syllabus in SPM is going to teach in Year 3 according to UEC, so we have to move the related topic from Year 3 to Year 2.” (DH4)

4.5.5 (d) Mathematics teachers’ perspective

Generally, the mathematics teachers’ opinions are in parallel with their department heads’ views. They are having problems to translate the content into lesson plans because of the different languages. They are also having problems to get sufficient references to strengthen their CK. Most of the time, they refer to oversea’s contents like China or Taiwan or they adapt from the national schools or CIHSs in East Malaysia which have already in their long history of learning mathematics in English.
“UEC does not have a comprehensive text book. Initially I always refer to STPM content which is in English as the main reference and translate into Mandarin the content. After that I found a reference book that the content is about 80 to 90 percent similar with UEC content. The content of UEC reference is quite limited, so normally I will find from the website and add in while I am preparing my lesson.” (T3)

4.5.6 Various methods of CK assessment

4.5.6 (a) Principals’ perspective

Findings revealed that school principals have created various methods to evaluate their mathematics teachers’ competencies related to content knowledge such as using students’ feedback from the computer system, special meeting every Saturday to discuss and improve mathematics teachers’ CK and building close work team relationship. The following are verbatim interview data:

“I also get feedback from students using computer system to know about teachers’ competencies. Due to some students may not do the feedback for every subject, therefore the school fixed the schedule for students to give feedback to every subject every three months. I need to know how the teachings are going on through students’ feedback on their own understanding towards their learning I did not ask students to give feedback on teachers’ teaching but their own understanding on the subject matter. By looking at students’ feedback I can know how effective is the teacher’s teaching and her CK.” (P3)

“Every subject, they have their research team, so these new teachers can seek for help in their own subject group. This type of meeting will have at Saturday and they will discuss what needs to cover, one year will have a few times.” (P2)

“Regarding students’ feedback on their own understanding, teachers will notice from the students’ feedback and make the necessary adjustment to ensure students can understand their lessons.” (P3)
“Our math teachers in School A are having more workload compared to other CIHSs. For example, School B, they only prepare for one version of math that is Chinese language but my teachers have to prepare for two version English and Chinese. Sometimes the text book for math in English is quite limited, we have to seek help from CIHSs in East Malaysia to provide the content in English or else our teachers have to translate.”

“We are gradually changed our math from teaching in Chinese to English even the commerce class. We also use English to teach math. We do not teach math in Malay language at all even for those students who are taking SPM. Most of our students’ proficiency their English are good enough and they are doing quite good in their learning.” (P1)

4.5.7 Students’ perspective on CK of their mathematics teachers

Researcher used singular question to ask about students’ feelings towards their mathematics teachers’ CK not their opinions or value questions. Researcher synthesized the students’ feeling in their learning process that related to their mathematics teachers’ CK. Generally, all the 27 students found that UEC advanced mathematics for senior secondary education is the most difficult subject in terms of its contents. Themes that created by researcher through the five cycles of focus group interviews with senior secondary education students are: (i) their mathematics teachers are very excellent in their CK; (ii) They need practice in order to understand the contents. Some difficult topics that they cannot cope are the same as their teachers highlighted.

4.5.7 (a) School A

S4 and S5 found that they are hard to adapt themselves to CIHS culture because of the high standard. According to S4 who was transferred from national school is having language difference problem since she is not good at Mandarin language. The medium of
instruction in CIHS and national school is Mandarin and English respectively. Most of the students like mathematics although it is a difficult subject.

All the students (S1 to S5) admitted that their teachers are good at their content knowledge and they agree to be good in mathematics need practicing.

“I think my teacher is very good in her content knowledge. I can understand what she taught. But if I am not practice it, also don’t make sense.” (S1)

“When I managed to finish math questions using various methods, I feel very satisfied and happy.” (S2)

“Teacher can teach all the content knowledge to us, but if we do not do our parts to practice them like doing a lot of exercise, we will forget what teacher has taught. If the student keep on cannot solve the problems, she will lose the confidence. But when we can do it, we will be happy and improve the confidence on math.” (S3)

“Although sometimes I spent a lot of my time to solve the problems until success, I feel worthy because I will know how to solve it in the exam as well.” (S4)

Most of the students found topics like trigonometry, geometry and elips are difficult. Since mathematics is a difficult subject, there are a few ways teacher used to help the weak students.

“Teacher gave individual teaching to those weak students.” (S2)

“Ask good student to teach weak students, we can be either one because we cannot be good in every topic.” (S4)
“If I am a small teacher to teach my friend, I repeat again, so I can remember better.” (S1)

4.5.7 (b) School B

All of them attend mathematics tuition class except S9 Out of the five students (S6 to S10), only one student is playing computer games. All the five students are having problems in handling mathematic topics related to something abstract for example trigonometry, geometry. According to S7, some teachers learned other subjects in the university but after he graduated he taught mathematics which is not his expertise.

“To me, all the subjects are difficult.” (S6)

“Math is not the most difficult subject but every subject has its own difficult parts.” (S7)

“Changing of the difficulty level on math from junior secondary to senior secondary is very broad.” (S8)

“There are a lot of different in term of subjective questions such as symbol and formula.” (S10)

“Especially geometry topic, I find teacher’s explanations not clear, I cannot understand.” (S7)

“Practice is important to solve the math problems.” (S6)

“If I faced problems, I will think by myself, sometimes I spend 4 or 5 days to think about it.” (S7)
“I will try first, if not, I will discuss with friends, then only approach teacher because teacher is always busy.” (S9)

4.5.7 (c) School C

All the students (S11 to S15) like mathematics and find it is interesting. The main reason they give is because of mathematics needs thinking and more challenging. In fact, all of them agreed that their mathematics teachers have sufficient knowledge.

“I don’t think mathematics is a difficult subject. But need to spend a lot of time to practice.” (S12)

“When you practice a lot, it will become easy already.” (S11)

4.5.7 (d) School D

Mathematics can develop students' self-esteem and confidence once they are able to solve the mathematics problems. Students found difficult to understand the different methods of solution to the questions.

“When I can find out the solution, there is a kind of satisfaction and self-esteem.” (S18 and S20).

“Our teacher always explain many times when she introduce new topic to us. This is to make sure we understand the contents.” (S18)
UEC mathematics is a difficult subject, not many students can cope with the high standard.

“I would like to say all topics are difficult.” (S18)

“Comparing to other subjects, applied math is the most difficult subject to us.” (S19 and S20)

“All the exam results, the applied math always be the lowest marks” (S18)

“Sometimes I find that we have some easier ways to get the answer, but in the topic, we must use the most difficult and complicated way like higher order thinking method to get the answer then only we will be given marks that make us sometimes very confusing. Sometimes we use the method to calculate it for more than 20 minutes yet we get the wrong answer because too complex.” (S18)

4.5.7 (e) School E

All the students (S21 to S27) agreed that their teachers have sufficient content knowledge. Some students (S21, 23, 25) feel that mathematics contents are not too difficult, some students feel that it is quite difficult (S22, S24, S26 and S27).

“The most difficult topics are gometry, trigonometry, 3D shape. All related to shape are difficult topic to us.” (S22, S27, and S27)

“It is difficult because the questions are different all the time.” (S27)

“It is very abstract, I cannot imagine…” (S21)

“The questions are very broad” (S24)
“I cannot think abstractly, I find very difficult in math.” (S22)

4.5.8 Summary of the findings of mathematics teachers’ CK

Findings showed that all the five principals are satisfied with their mathematics teachers’ competencies in the areas of CK except the new teachers. As a result, they have developed their administrative system to ensure all their mathematics teachers possess sufficient CK to prepare CIHS students to achieve the high international standards of UEC. For example, they set up their criteria of recruitment, regular classroom observation mechanism, monitoring lesson plans and various methods have been employed to assist those new teachers to develop their CK.

In addition, all the five senior assistants’ views are in accordance with the principals’. They are satisfied with their mathematics teachers’ competencies in the areas of CK except the new teachers. Consequently, findings showed that senior assistants are using the other methods to develop their new mathematics teachers to possess sufficient CK. For example, they are more concerns on students’ feedback, peer assistance monitoring system, regular meeting, and do the lesson plans together to assist those new teachers to develop their CK.

One of the significant findings was highlighted by mathematics department heads neither principals nor senior assistants regarding the CK problem is too many different types of mathematics examinations that students have to take. As a result, mathematics teachers need to have various source of CK to integrate into their lessons. Besides, they are lacking of references and guidelines to assist them to organize their CK. The findings
from mathematics department heads are found to be consistent with principals and senior assistants are criteria of recruitment and new teachers’ insufficiency of CK. Finally, they have the same views on classroom observation is ineffective to develop CK of mathematics teachers.

Furthermore, one of the significant findings from mathematics teachers themselves that is found to be contradicted with their immediate leaders like principals and department heads is related to their criteria of recruitment. To them, they have sufficient CK even though their specializations are not in mathematics. They gained their CK from their teaching experiences. They argued that students cannot cope with UEC mathematics because of the UEC contents are too difficult and high standards not because of they are lacking of CK. However, they agreed on the point that new teachers are having problems in CK but the team working and mentoring cultures are very positive in CIHSs so experienced teachers are always helping the new teachers to develop their CK.

Finally, none of the students felt that their mathematics teachers are lacking of CK. However, they found the applied mathematics is a very difficult subject yet they like this subject and find it is interesting and challenging. They did not complain about their mathematics teachers’ CK and they understand that only practices can make them understand the content well.
4.6 Pedagogical Content Knowledge of Mathematic Teachers from the Perspectives of School Principals, Senior Assistants, Mathematics Department Heads, Mathematics Teachers, and Students

A total eight themes about what constitutes to mathematics teachers PCK were identified after a thematic analysis of the transcripts from the five principals, five senior assistants, five mathematics department heads, and 13 mathematics teachers. The 27 students’ transcripts were analyzed holistically. The PCK was examined based on how the mathematics teachers shape their teaching and learning process in the classroom, their abilities in classroom management, their planning of learning process, knowledge of student development, their diagnostic skills or competencies toward those weak students, and their competencies on assessment of students’ performance. These eight themes were (i) the importance of PCK; (ii) training is important to improve teachers’ PCK; (iii) classroom observation to verify PCK; (iv) PCK of teachers and their specialization; (v) diagnostic skills of teachers towards weak students; (vi) competency in using teaching aids; (vii) classroom management competency, and (viii) assessment of students’ performance competency. Table 4.3 summarizes these eight themes and the composition of each participant’s views.

Table 4.3 shows that PCK is the most important component when assessing a mathematics teacher’s professional competence. Mathematics teachers who possessed high level of PCK competency will be able to diagnose weak students and improve students’ performance, followed by well preparing teaching aids and able to manage class appropriately. Training and classroom observation can be used to improve mathematics teachers’ PCK level.
Table 4.3 Participants’ view about what constitutes PCK of mathematics teachers

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<th>Themes Of PCK</th>
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Notes: P – Principal; SA – Senior assistant; DH – Mathematics department head; T – Mathematics teacher

4.6.1 The importance of PCK

4.6.1 (a) Principals’ perspective

Majority of the principals have high expectations toward PCK of mathematics teachers. However, they are not so satisfied with their mathematics teachers’ PCK as they...
are not creative, using different teaching aids and diversity of teaching strategies. Those elderly mathematics teachers refused to use different methods to teach their students. Principals are expecting mathematics teachers to improve their PCK competency to ease the high standards of UEC.

“Teachers are expected to use technological teaching aid to present a higher quality of teaching while they are being observed. I also expect to observe something different from normal performance while I am doing my classroom observation.” (P5)

“However, math teachers have to alert and flexible in pedagogical teaching method.” (P3)

“Of course, nowadays the method of teaching not so traditional type, all the classroom have smart board, teachers are encouraged to use multi-media teaching aids to teach.” (P1)

“Most of the math teachers especially the elderly ones would like to use the traditional method and refused to try various teaching methods. This is the parts that they should improve. However I see my young teachers are more willing to try new method of teaching. Therefore my teachers always get prize in competition using power point to teach. Out of the eight sciences and math teachers who went for competition recently, five of them became winner and got the prize from Dong Zong. We also bought some software from Taiwan, the company had competition at world level, my teachers also won prize over the past three years.” (P2)

“I can see my math teachers have used many different strategies to teach, their pedagogical content knowledge is quite good.” (P4)

“Applied math in UEC is very difficult. Some teachers are very smart using various method and flexible to teach but there are also some teachers who are not flexible just used the same method but if the teachers are patient and loving the students, it still work but slow, teach them step by step. However a good teacher who are
flexible and use various method to teach, depend on our luck to get this type of teachers. Although we can train them but not all will work. If those who cannot teach well, I will change them to teach junior UEC.” (P3)

“This is education whatever Dong Zong fixed, we just have to follow but cannot change. We can only adjust our teaching method.” (P1)

4.6.1 (b) Senior assistants’ perspective

Generally, all the five senior assistants felt that their experienced teachers do not have problems in their PCK competency but new teachers need time to develop PCK competency.

“In School A, students’ performance in UEC exams were not very much different over the years. Generally all the experienced teachers do not have problems in CK or PCK but for new teachers who have just one to two years of experience, they are quite lacking in PCK.” (SA1)

“If I want to see the teacher’s PCK competency in teaching, I would like to see how much efforts the teacher put in to help the students, the exercise that the teacher give is relevant and sufficient or not.” (SA5)

4.6.1 (c) Mathematics department heads’ perspective

Based on the responses from the mathematics department heads showed that they still perceived experienced teachers are very excellent in PCK. They all agreed that different types of student have to use different PCK. However, School A, B, and C fixed certain day of a week for meeting to share the better PCK among the teachers seem to be effective.
“Since the gap of students is broad, I find that experienced teachers know how to use different pedagogical content knowledge to handle the different types of students but new teachers still cannot do that.” (DH1)

“One of my math teachers has a special method to guide the students. He gave the students the concept only, students are required to find their solution. But this method just can be applied to good students like science stream student. We only have one class UEC science.” (DH1)

“I try my best to help my 14 team members to develop them with PCK. I have 14 math teachers under my administration. This is the school principle whereby during Friday, all the math teachers will have 3 periods free of teaching and we gather together to discuss about our problems. Sometimes teachers at the same form will reflect on what had been taught last week and what should be taught on the coming weeks. If among themselves they face some problems, they will refer to me, I will give them some suggestions.” (DH3)

“Teacher can understand but not necessary students can understand. So teacher must involve in professional development to be quality teacher that is my experience. So I must very flexible in using different methods of teaching to different level of students. You cannot use one method to all students because you have good, moderate and weak students. So different topic also need to consider about what are the suitable method to teach our students. Every year I face different types of students, I always change my method of teaching.” (DH4)

“New teachers have to prepare their lesson plan with the senior teacher. Different teachers have their different innovative style of teaching. I encourage my new teachers to learn from many other teachers, ask them to access internet to find innovative teaching method.” (DH4)

“I like teaching and I have been teaching for so many years because teaching is very fun. Every year you will face different types of students and they will give some surprise. Some students can argue with you with their own ways of solutions but I will tell students that yes you have your own thinking, but if you use your method you may not get marks because of the marking scheme. So teacher has to let her students to explore themselves. Nowadays students are very exerting.” (DH4)
4.6.1 (d) Mathematics teachers’ perspective

Majority of the mathematics teachers’ opinions are found to be in line with their department heads’. They agreed that PCK is the key competency of teachers and they have to use different teaching strategies to different abilities of students. To teach the fundamental concepts and linkage between one topic to the other topics are important as parts of the PCK competency.

“Teacher has to use different methods when we are teaching different capabilities of students. This school is streaming. The first class and the last class, we will use different methods.” (T2)

“PCK is very important in teaching math. When I start a new topic, I will explain the content of the whole topic, emphasize to them which parts are important in this topic. So that students can have a clear picture about the topic. I find this method is effective because along the way of teaching this topic, students can understand better. When I reach the important parts, I will emphasize which parts they should pay more attention and the particular parts occupy how many percent of the total marks. More practices will help them to overcome something that they cannot think abstractly.” (T2)

“Math is a practical subject, we can only understand through practice. Normally I won’t let my student copy. After explaining the mathematical concept, I will give a related question, all the math questions for each topic has related to the previous topic. My method is I will complete half of the question using the concept that I teach today, and student have to complete it themselves by referring to the previous concepts that they have already learned and find the connection by themselves.” (T3)

“My principle is I never solve the math questions on the blackboard, because student just copy without learning. If my class has 20 students, I will ask them which questions they do not know. If most of them do not know how to do Question No. 2, then I will tell them have to use this or that formula, just tell the procedure, students have to do by themselves. Other than that, I also used those good students to teach the weak students. Once they have taught their friends they do not need to
study anymore because they have become expert already and remembered the method of solution very well. This method is win-win because we can help both the good and weak students.” (T3)

“Students said that they know each topic but when come to exam, they have problems how to put the different topic together. They know topic by topic but they have difficulty to combine them. Being a math teacher, I always remind them to relate to previous topic. For example geometry questions were related to straight line and angle, and square two, so have to remind students.” (T5)

“Currently, I try on a teaching method which is more student centred teaching. For example I ask my students to discuss in group and prepare the lesson in ppt. Then let them present. Teacher will be the facilitator and give explanation if necessary. I record their marks. I find this method is quite effective. The way student react to our teaching can show to me whether my students understand today lesson or not.” (T10)

“It has been two years already we did not teach SPM and we just have UEC only. The medium of instruction that we use in class just only Mandarin. Most of the time, I need to find out myself the method of teaching because applied math in senior UEC is really hard.” (T12)

4.6.2 Training is important to improve mathematics teachers’ PCK

4.6.2 (a) Principals’ perspective

All the principals are satisfied with the training provided by New Era College to promote their mathematics teachers’ PCK. However, all the principals are very encouraging their mathematics to go for external training. They also provide internal training from time to time to develop their mathematics teachers’ PCK. P1 hoped that Dong Zong can provide direct training to all the mathematics teachers in CIHSs so that
they can be well prepared in their teaching. P3 suggested that training itself is not sufficient to polish up teachers’ PCK but practice after training will be more practical.

“We also send new teachers for training in New Era College. The training is two and a half years. It depends on when the teachers join the school, sometimes when they join that time, New Era College does not start a new class yet, then have to wait until they start a new class. This school is keeping on increasing students, more and more teachers are recruited, so almost every year I have to send my teachers out for training.” (P3)

“We have internal training my head department is able to train them. Most of the new teachers are trained by head department or senior assistant. Every Friday, every department will have a meeting discussing on the problems and the solving method related to teaching and learning. This meeting starts from 2.30 to 3.30 for an hour which I have scheduled accordingly for every subject. Major concerns during this type of meeting are teaching, examination, and designing questions for certain competition which is focusing on PCK.” (P1)

“If Dong Zong provided any new course, we allowed our teachers to go for training. After those teachers came back from training they have to give in-house training to their colleagues.” (P2)

“I have given them various support systems such as we have reflection group, provide outside course training when holiday, mentor mentees system. Every month we conduct sharing sessions, sometimes other subject teaching method can be useful. For example one of my history teachers used a very effective teaching method and many teachers found it can be utilized in other subject as well.” (P4)

“The professional teaching training in New Era College whether is effective or not, it is depending on individual teacher’s intention. Of course, if they go for this type of training, it will help them. Some teachers did not go for the training, but have the intention to grope also can get effective strategies to teach and very confidence. While those who go for training but come back did not practice also would be forgotten and it is meaningless. But teacher are professional, they have to get professional certificate for assurance.” (P3)
“Regarding training for math teachers, we sent some teachers to Dong Zong or other internal training by head department but my English teachers have online training. Actually what we need is direct training related to teaching method for teachers to teach applied math. I hope very much that Dong Zong can provide direct training to my teachers because the change of format and the experts are with Dong Zong, they should provide direct training to the teachers.”  (P1)

“Senior teachers who are good have no time to train our new teachers because they also have to teach. This kind of training is not necessary from Malaysia. For example one of our sister schools in China, I request the trainee from them because China high school, their math level of difficulty is almost the same as our UEC. We also sent our teachers to learn from our outstanding CIHS in Johor because it is the biggest CIHS in Malaysia. They have over hundred of teachers, math teacher team also a big group. Teachers also are quite experienced and senior.”  (P1)

“New Era College gives training to CIHSs in the north by sending trainee to one of the CIHSs. Last year, they have training in School C because this is easier for four CIHSs to send their teachers to school in island, rather than to School B because we are at mainland. According to my teachers, they said the training is useful to them. Most of the training are related to examination, and teaching.”  (P2)

4.6.2 (b)  Senior assistants’ perspective

Generally, all the five senior assistants pointed out that training should be more practical rather than knowledge transfer. Current advanced technology should be taken into consideration by New Era College to modify their training program accordingly.

“The teaching professional training in New Era College is relevant but not practical. This is because our society is keep on changing to information technology era, so some content may not be able to practice at the real situation. For example, nowadays if teachers cannot utilize Whatapp to communicate with their students, they cannot understand their students well. So teachers have to keep on improve themselves to suit our students who are right up on the top of the high technology world.”  (SA1)
“My teacher PCK competency is caused by the New Era College teaching professional training or not, or caused by our internal daily teaching experiences, or any other factors I cannot answer because there is no any research to prove the relationship of this training with teachers’ competencies. Of course this kind of training is very directly related to the classroom practice but from my experience, those teachers whom we employed either from education background or not, did not reflecting the PCK competency differently. Just like me, I graduated from engineering, but I teach Chinese language at the beginning of my career, partly because I have the experience of newspaper reporter. A graduated candidate from university in which ever field is found to be sufficient for the person to teach in high school for any subject. This is because current education, teacher’s PCK competency is more on applying the skills in career and daily life rather than just providing knowledge.” (SA5)

4.6.2 (c) Mathematics department heads’ perspective

Based on the mathematics department heads’ observations, they found that the professional training provided by New Era College helpful in improving their mathematics teachers’ PCK.

“All the teachers as long as the board of director and school decided to employ them for long term, will definitely send to New Era College for teaching professional training for 3 years. Last time, they do not need to go the New Era College, they attended the training in one of the schools in north region, for example Jit Sin, Han Chiang and so on. But recent years, they have to go to New Era College. Although I never attend this type of training before but I found that those teachers who came back from the training, I can see there is a change on them in term of their PCK. However some of the theories that they learned not necessary they can use or practice in the classroom.” (DH1)

“New Era College teaching professional training, of course they are helpful in our daily career. Sometimes we may use it indirectly without noticing it.” (DH2)
4.6.2 (d) **Mathematics teachers’ perspective**

All the mathematics teachers found that training given by Dong Zong or New Era College really assist them in handling their teaching process. They found themselves improved a lot in their PCK after attending the training.

“Since the change of UEC exam format last year, normally I will separate out the questions. Now students have to do the two separate parts and combine later. This is what I learned from Dong Zong through their training on how to tackle the UEC exam questions.” (T4)

“Dong Zong will send text book before they changed the format. Dong Zong provides training to teachers on how to use the textbook. They also provide some useful materials to those teachers who go for training to bring back to their own school to share with the colleagues.” (T4)

“All the us have attended the teaching profession training in New Era College. We found that the training is useful to us. They attend many related courses within the two years.” (T4, T5 and T6)

“The training covers a lot such as counselling, Malaysia educational history. But the two years we do not have holiday, have to do assignment.” (T6)

“The coverage of the New Era College training is quite comprehensive such as psychology, assessment, Malaysia education philosophy and so on.” (T13)

4.6.3 Classroom observation to verify PCK

4.6.3 (a) **Principals’ perspective**

Most of the principals agreed that there is still room of improvement for their mathematics teachers’ PCK. PCK does not have direct association with teachers’
specializations not like CK. Majority of the principals still consider classroom observation is one of the best ways to evaluate teachers’ PCK competency.

“This classroom observation report will be a reference for us to decide whether we should continue her contract or not. If teachers have problems in their teaching or PCK, I will discuss with the teacher personally face to face after the class. I also see my head department so that she can put an eye on the teacher. I also put myself as student, if I cannot understand what she teach, I will comment on the method or terms that she used not appropriate. We have evaluation form, we are very professional, we look into various aspects while we are evaluating our teachers’ performance, for example teaching method, interaction between teacher and students, teaching aids and others.” (P1)

“I do classroom observation only to new teacher, for those experienced teachers, I did not observe them. They will be supervised for four times a year, two for each semester. The leaders who may observe these new teachers from the possibility of four persons, namely principal, senior assistant principal, administrative leader, and head department. Normally it was done randomly so that to be not subjective.” (P4)

“When I observed my math teachers, I would like to see their time management competency in order to make sure that there are not much different from their lesson plan as one of the PCK criteria.” (P4)

“Most of the teachers whether math is their option or not their CK is sufficient. For me, tertiary education is not really help in CK, you see this new teacher, her option is math, but she is not really teaching well. PCK is her major problems. Experienced teachers know what kinds of teaching method are suitable to their students” (P4)

“Classroom observation will be scheduled at the beginning of the academic and each teacher will be observed two times per year. In order to have better performance, teachers are informed when they are going to observe by school administrators as myself and senior assistant. Teachers are expected to use technological teaching aid to present a higher quality of teaching while they are
being observed I expect to observe something different from normal performance while I am doing his classroom observation.” (P5)

4.6.3 (b) Senior assistants’ perspective

Most of the senior assistants stated that new teachers should be given opportunities to observe experienced teachers’ teaching so that they can improve their PCK tremendously. Sometimes, explanation skill of the mathematics teachers can be an important competency needed.

“Teaching methods cannot be effective to every class. Teacher has to explain clearly to students so that they can understand. Normally, we require new teacher to observe other experienced teachers’ teaching. The math head department is very good, she always invite the new teacher to observe her teaching.” (SA1)

“Math teachers are using diversity styles of teaching. From my observation, at least more than half of the math teachers are using various method of teaching. For example, I see they tried to use competition to motivate students to study math. Of course some teachers still use traditional method to teach.” (SA2)

“Definitely when principal and I go to observe the teacher’s teaching normally it will be very comprehensive because they have been notified before we observed”. (SA5)

4.6.3 (c) Mathematics department heads’ perspective

Most of the mathematics department heads found that classroom observation can help them to detect the PCK problems particularly on their teaching procedure which is very important in gaining marks of UEC. DH3 is found to be unsatisfied with his teachers’ creativity in PCK.
“Most of the new teachers have problems in their PCK but they do not have problems in CK when I observed their teaching. I find they all can transfer very well the knowledge with appropriate method. Because they can make the students really understand. Unfortunately, I find that they do not design more proactive activities for students involvement is something lacking in their teaching. This is the wrong concepts, we always think we need to learn a lot but to me we should teach in deep not in term of quantity but more on quality.” (DH3)

“New teacher, I will observe them teaching. I will suggest some methods but I will not condemn their method. Just suggest some methods can make students understand and clear about mathematical concepts.” (DH4)

“If I found my teachers teach wrongly, I will not tell her on the spot but I will ask her to come to my office to discuss about it. Later, I will make sure that she makes the correction to students. I will advise her how to use the proper method to avoid the mistake, for example –3, minus negative 3· not minus minus 3∙ students will answer plus 3∙ Every time I have to see the questions from the left, of course we do times divide first before plus minus. After I corrected my teachers who faced math problems I will follow up. I always advise my teachers to avoid memorizing but must understand Maths cannot memorize.” (DH4)

4.6.3 (d) Mathematics teachers’ perspective

T11 is a new mathematics teacher who found herself improved a lot in her PCK competency after she was being observed or she observed experienced teachers’ teaching. Both methods are found to be useful.

“I have been observed two times by senior teachers. For me the two types of observations are also good. For example, they are more experience they have some technique or teaching method that I have learned from them. The first type, when they tell me how to improve my teaching method, I also learned to improve my PCK.” (T11)
4.6.4 PCK of mathematics teachers and their specialization

4.6.4 (a) Principals’ perspective

P1 argued that PCK is more important than CK especially to mathematics subject. This is because students can understand well if mathematics teachers have a strong competency in PCK. Most of the principals agreed that there is still room of improvement for their mathematics teachers’ PCK. PCK does not have direct association with teachers’ specializations not like CK. Majority of the principals still consider classroom observation is one of the best ways to evaluate teachers’ PCK competency. This is because mathematics is not a fixed body of facts and the learning process cannot be conducted by memorization.

“If I compare my 15 math teachers, generally they are more competent in CK rather than PCK. However those teachers who are from math background, I can see their strengths in PCK. The same topic, the pedagogical method that used is better and can make the students understand well. They explain clearly how this formula is derived so that students do not need to memorize especially for applied math in UEC, very difficult only those teachers who are math background can make it very lively and flexible.” (P1)

“Those teachers without math background will directly raise the formula without explaining how this formula comes from. Those teachers will just give examples from easy to difficult, and let students practice it. They demonstrate all the content but the method is very direct and not flexible. There is the different between teacher with and without math background in their PCK.” (P1)

4.6.4 (b) Mathematics department heads’ perspective

Majority of the mathematics department heads pointed out the importance of teachers’ expertise related to their PCK, it has a direct effect on students’ learning. They
also found that understanding students’ abilities is a prerequisite for teachers to design their PCK.

“These non-option math teachers have problems in PCK. Because these teachers teach depend on what they read. Actually, one math question can have various ways of teaching but most of them will use the method that they familiar. So if students have problem, they will ask the students to memorize and use this method only. In fact, we should use different method to suit our students’ abilities in math. Moreover, teaching math needs experience other than you read from book as a theory only. They have to be flexible to change according to situation.” (DH1)

“Besides, teachers’ option is very important as well in term of PCK. Only I and the other two teachers who born in the 90’s are optioned in maths, the rest are not. That can be a factor.” (DH1)

“My option is not math education. Of course when I taught them at the beginning, I received many complaints from the students and I have been called to see principal. Principal told me that I taught too fast, I gave the questions too difficult. At that time, I always asked myself why I taught for so many times, students still cannot understand. So in education, as a teacher we must understand our students’ ability level. That is why I faced this type of problem. This is not the students’ fault. This is because of I do not understand them at all. To my opinion teaching training is very important to a teacher.” (DH4)

4.6.4 (c) Mathematics teachers’ perspective

T3 is an experienced teacher and gained a good rapport with his students. Thus he allowed students’ challenging questions and developed together with his students.

“Yes, sometimes student can come up with different way of solution but have a correct answer too and may be different from mine. Because of my 30 years experiences, students normally can accept my method rather than their friend. Of course, sometimes student can come up with certain solution in a faster way. I will
admit and tell the students this way will be faster. Once we set up our professional image, students will respect and trust the teacher.” (T3)

4.6.5 Diagnostic skills of mathematics teachers toward weak students

4.6.5 (a) Principals’ perspective

Most of the weak students are due to their weak foundation. Majority of the principals are confident with their mathematics teachers’ diagnostic skills. They emphasized on mathematical learning process rather than give up the students. Most of the principals are helping their mathematics teachers to deal with the weak students.

“What can I see is those students are lack of foundation, so teachers have to start from the beginning. For example, some students although already in lower secondary year 3 but they are lack of math foundation skills even in year 1, teachers have to teach them the year 1 math. On top of that, most of the time, teachers have to simplify the questions or else they cannot answer the question. Besides, their focus time is very limited. Teachers have to make sure students are focusing on their teaching, call their names if they do not pay attention. But most of my math teachers are very patient. It is not an easy job.” (P1)

“Most of them always questioning their weak students, usually ask them to come forward to answer math questions at whiteboard. Some weak students not only not pay attention but also have problems in doing homework. We are checking students’ homework. Normally I pay more focus on weak class so I always choose to observe more to weak classes and also those teachers weak in their teaching.” (P1)

“My philosophy on education is the process of learning although result is important but the process even more important. I also advise my teachers not to give up those poor students. This is because math is important even though they can not get into university but math is important in their daily life. Every student should have equal opportunity to get education.” (P4)
“For those students who refused to complete their homework, most of time principal will take actions such as required them to stay back after school, forced them to attend extra classes and advised them.” (P5)

4.6.5 (b) Senior assistants’ perspective

Based on the responses from the senior assistants showed they have a different understanding on diagnostic skills of teachers toward the weak students. Some CIHSs have guided class formally (School A and School B) and informally (School D and School E). Experienced mathematics teachers have their own ways to deal with weak students successfully. School E seems to have a different philosophy in dealing with weak students by not giving up any of the weak students.

“All the teachers at the same form must follow the yearly planning. If the teachers teach weak classes, they need to explain in a simple way only but they still have to follow the progress of the topic according to the yearly plan.” (SA1)

“Generally those teachers who can manage to cover the related topics one week before the internal exam, they will do revision with the students to revise and link all the topics together if they are related. This will help to improve students’ understanding. But some teachers cannot finish the topics on time. They will not do the revision. With and without revision before exam make a difference in students’ performance in the exam.” (SA1)

“When I arrange the teachers for the weak classes in particular, I have to do some research and allocate those teachers who are patient and can guide weak students to teach the weak classes. Some teachers’ personality really not suitable to teach the weak students, then I will try to avoid this matter. In School A, teachers’ preparation for the lesson is very heavy because they need to cater not only for UEC but also IGCSE.” (SA1)

“We are also arranging the guided class after school to guide the weak students based on their internal exam results. This kind of guided class has been conducted
for a few years. Students are selected based on their achievement so they come from different classes and put the same level of students together. Our math teacher will teach them according to the parts that they are weak in, based on the topic to guide the weak students. Every week, the guided class will be conducted for 1 hour and 10 minutes.” (SA2)

“These math teachers not necessary are from math option. Sometimes they are not pure math, but either their minor or major are math. Teachers always help the weak students by providing them some extra basic foundation questions from junior level that related to senior math to help the students.” (SA2)

“Because of I myself is a math teacher, I always can help my math teachers. Those students have problems in math, I always encourage my teachers to give them individual guidance. Normally students may stuck in certain parts of the solution, we have to find the source why and which part made her cannot continue, I will ask her, explain to her, let her understand the overcome the parts that hindered her from continue.” (SA4)

“My teaching method is highlighting the parts that students always did wrongly, this is based on my experience. Our students are not that smart until can ask very challenging questions so most of us have sufficient CK to handle our students. After explaining those mistakes they normally did, I will give them group teaching. Sometimes give them quiz. I feel that teachers cannot teach all the times, students feel bored and make noise. Therefore we must give them some activities.” (SA4)

“The most direct way of knowing students cannot cope with our teaching is from their homework. Because of math, every day has homework for them.” (SA4)

“Our students do not practice their homework at home. Going back home never do homework. Partly because of the school put very low entry point. Only start from this year, we did not accept students below 30 marks. Over the past years, we offer to even 20 marks plus students. Therefore, teacher roles are very much important to deal with these weak students.” (SA5)
“These weak students generally related to their families, most of them are very intelligent. Because of our students are weak, so teachers have to allocate some exercise for them to complete during class is better because at least they learned something with the teacher’s assistance. Our school principle is cannot let the students copying their works, we always have to remind teachers. Practice effective exercise work sheet is encouraging rather than let the weak students to copy.” (SA5)

“I can see these math teacher can help the students with their own methods. From the past observation, teachers have produced a few Grade A students and helping those weak students to pass. Some weak students in this school are really weak, lack of parents’ guidance. With this kind of weaknesses, these math teachers still can pinpoint some important topic, method to push these weak students.” (SA5)

“Teacher (T12) that you interviewed just now can manage these weak students, he always taught weak class, yet he can manage the students to reach the 60 percent passing mark by the end of the day.” (SA5)

“Current students if we want to compare to the taxonomy Bloom, they are just at understanding level. For me, students should learn to upgrade the skills up to the higher level.” (SA5)

“We always encouraged good students to study independently. They should try more than 10 years past year questions. If they faced problems, they discussed among the team. As I said in School E because the number of class is small, so we cannot have extremely good class. So even among the weak students, they are many levels of weakness. But in education, we must understand education not only to prepare them for exam, but also to prepare them for working in the society. This year we even accept 7E and 1D students. Sometimes we have to give opportunity for this weak student to learn. Sometimes these weak students have better attitudes which can make them survive although they do not have good results.” (SA5)

4.6.5 (c) Mathematics department heads’ perspective

Generally, the mathematics department heads were very confident with their mathematics teachers to have diagnostic skills and most of them like to use ‘small teacher
approach’ to overcome the weak students’ problems. All the mathematics department heads agreed this ‘small teacher approach’ is an effective approach to diagnose weak students. They found that weak students can learn better from their friends than their teachers. Sometimes, the extra classes given by the schools are ineffective.

“I found effective method is group teaching and more practical. So I divided my students into their levels, and give the different levels of questions to the group to do. The weak group, I will assist them more while they are doing the questions.” (DH1)

“For weak students, school has taken these actions for example tuition class and strengthening class. Personally I am not so agreed with this method. Firstly, the same number of students will attend the strengthen class. In normal class, for example, I have taught them using the three different methods to teach, some of them cannot understand, I have to use different language to repeat. The same students come to this strengthen class. So I have to repeat whatever I have done in the normal class. Secondly the class size is too big. Unless we split up the students into good and weak, and have the strengthen class at different time, then I think that will be effective.” (DH1)

“Another matter I would like to raise to you as well as later to principal is if you put all the three classes of students in one strengthen class and give to one teacher, will it be effective? I don’t think so.” (DH1)

“So sometimes I pity my teacher at Junior Year 1 second class and third class, some students are really very weak. Partly because of the entry point is low, as long as the students can pass our internal entry test, we will give them our offer. Good students go for IGCSE and left behind a few good students in UEC. Moreover parents also know that UEC exam more difficult than IGCSE, so parents love their children, do not want their children to suffer.” (DH1)

“The major problem that math teachers faced is students who cannot think abstractly. We got ask people to make the 3D model, sometimes I demonstrate the real thing to show to them, for example ball, box so that they can see it. My style to
solve the students’ foundation is not good, is like that I let my students to have free sitting. But after the minor test, I start to change their seats. I arrange one good student to responsible to take care of one weak student. Sometimes I gave them pressure. They must finish their work only can go back. Not only the good student finished but also the one that they guide, at least in the ratio 3 questions finished by good student to 1 question by weak student, but must make sure the weak one did by themselves, do not let them copy. At first students make noise, when I set this regulation. But I have no choice because teacher cannot guide so many weak students. One class we have over 40 students. Sometimes I find that the same simple question, weak student can understand better from their friend’s explanation than teachers. I have explained many times, he still cannot understand but when their friend teach them just one time he can understand. “ (DH2)

“How I diagnose weak students? During the teaching and learning process, from their face expression, we can know whether the student understands or not. Normally, I will start to give practice based on the standard related question in text book. For example, after I taught that topic, I will ask students to answer 5 out of 10 questions in the text book. If they do not know how to do, ask me or their small teacher.” (DH2)

“My principle is ‘do not let student copy’. For me if the student copy the answer for 100 questions is useless than he just did 3 questions. So the weak students if they can finish by themselves only 3 questions, I am ok with it. I tell my students to do certain topic of questions and told them these questions will come up in the exam, at least try 3 out of 10 questions, and they can get some marks better than get 0 mark.” (DH2)

“To know our students’ progress, normally I will look into their exercise books, their expression, we will know whether the students are stuck or not. For weak class we will give some simple questions but good class will give more challenging questions.” (DH3)

“In order to help the weak students, I ask students to send message to me or email to me if they have problems, or come to see me at my office. Because this is my first year teach senior secondary Year 3, so I take it as we learn together.” (DH3)
4.6.5 (d)  Mathematics teachers’ perspective

All the mathematics teachers have their own ways to diagnose their weak students. Several methods have been suggested by mathematics teacher, such as simplifying the questions, having group teaching, spending extra time to guide them after class or after school, teaching the basic concepts, using concrete examples to help the weak students.

“If students’ foundation is not good, I cannot do much. What I can do is try to push them or change my teaching method. Other teaching method is I try to use group teaching. So I want each group try out the same question or the same pattern questions. Each group has to send representative to work out that question at white board and we discuss together.” (T1)

“The major problem why students are found not be interested in math because of their confidence. For me, weak students have to encourage them to improve their confidence then only they will gain interest. Do a lot of practices can make a different result. So I always encourage my weak students to do more.” (T1)

“I just like T3, whereby I divided my students into group and choose a leader to lead the group. Leader will become small teacher to teach other weak students. I always tell my students the importance of math because math is 5 marks as a core subject not like drawing art or other elective paper.” (T2)

“I also have the same as T2 and T3, by utilizing group teaching. Sometimes I encourage them by giving marks for their involvement in the group. Sometimes leader has to present.” (T1)

“Weak class, teacher has to lead them. In weak class, I always teach them step by step. Every step has to make sure they understand. Always questioning them whether they understand or not. If not teacher has to repeat.” (T2)
“For very weak students, you know math need to think something in abstract, they really cannot. These students will be asked to meet with me after class, during recess or school, giving special guidance. Of course, sometimes weak students cannot completely finish the whole questions but certain procedure they can do, at least they will get some marks. Most of my students are weak in geometry or something to do graph, they cannot imagine.” (T2)

“The source of the weak students is because of their foundation problem. Teacher must know which topics are important. For example, applied math, the trigonometric and geometry questions are already taken up 30 to 35% of the 100%. So students must practice more. These topics are considered difficult because a lot of formulas and the changes of question styles also quite vary. These two topics if students can master will be very good. My principle is must practice more because formula is not memorized it but is through practice it automatically students can remember.” (T3)

“After finish one topic, I will choose the related questions from past year to let my students practice. They do not have much time to do others, do the past year first is important. I will move on the following topic once I find that my students have already reached the UEC target that is about 30%, they can pass already. I will move on. I based on UEC exam passing mark.” (T3)

“The main challenging in math is students have to memorize formula, a lot of formulas they have to remember. So every time I introduce the formula, I have to link with the previous formula so that they can understand well. I also do not let them memorized without understand the link between the formulas. For example, sine, cosine, tangent, and pythagoren theorem are the difficult topics. So this kind of teaching method only can be applied to good class. If I go to weak class, I cannot do that, I just paste the formula on the blackboard and let them memorize.” (T4)

“What we learned in university and what we practice definitely there is the gap. All the CK we know and understand but students cannot understand. Weak students cannot cope with the difficulty of math, very difficult to make them finish their homework. The weak class, I did not let them go back to finish the homework. Most of the times I will guide them to make sure that they finished all the work by today,
do not accumulate the works. If you let them bring back their work, they will just copy only. But the good class can let them do it at home.” (T6)

“I always tell the students when they go to universities, they will know how important is math. All the teachers (T4, T5 and T6) agreed that the most difficult topic is trigonometry. No short cut, students have to practice more. Most of the time, I have to change the whole questions. Yes, another difficult topic is geometry, they really cannot know how to cut.” (T6)

“Most of the time we will simplify the difficult topic, cut down the questions for weak class. Some important topic in the exam, we will set more questions. Past year questions are important to make students feel familiar with the format and method of solution.” (T6)

“For weak students, I will offer them to come and see me after class. Some weak students dare not want to ask in class because they afraid of their friends will laugh at them. So from the face reaction, I notice these weak students cannot catch up, so I will give individual guidance.” (T7)

“I do revision for those weak students during holiday time. Sometimes I let the students practice back the junior secondary UEC math because their foundations are not good.” (T11)

“I have some small technique to teach my students who have difficulty in learning sine cosine tangent. Remind students to look at the 90 degree angle, students always confused which line divide by which line, so I teach them if sine, you divide this long line with cosine, you divide tangent is the two lines... But in the textbook stated in a complicated way, students cannot understand. The most important is the concept must be clear. Other teachers may have other method.” (T13)
4.6.6 PCK competency in using teaching aids

4.6.6 (a) Principals’ perspective

Majority of the principals are supporting their mathematics teachers to use teaching aids. With the advanced technology, mathematics teachers’ PCK has to be improved because conventional methods of teaching methods are not suitable to the current needs of students. However, most of the principals still not satisfied with the PCK competency reflected by their mathematics teachers.

“We are using the Taiwan software and found very useful to students according to my former head department, this software provide interaction with teachers and suitable to students. I am very supporting the practical person therefore I allow my teachers to purchase any teaching material if they need. In our syllabus, not much emphasized on practical which I am not agreed. Therefore I purposely arranged time allocation in schedule to let students have practicum. I found that effective teaching in math is more on practices” (P2)

“School has bought some software and pedagogical teaching methods from China to assist teachers in their teaching method such as ‘flipped classroom’ method. This method is students learn the problems from their daily lives and bring the problems to the classroom to study how to solve the problems. This method is bring the most important parts of learning to the classroom and three types of learning process including students learn independently, think and present what they have learned. When students are able to present what they learned means that this has become parts of their knowledge already. Therefore, students have to learn independently by themselves at home. Then they have to think and digest what they learned. Finally, they have to present what they have learned in the classroom. This teaching method has proved to be very effective because students learn proactively. In Singapore, ‘flipped classroom’ schools have been established. However most of the teachers do not want to use this teaching aid because they found that wasting a lot of time. This teaching aid is very useful, students learn more than usual but teachers have to do a lot of preparation that caused them cannot finish their syllabus. This is because the whole topic has to break into a few sub-topics, for each sub-topic, teachers have to design the lesson by themselves accordingly.” (P5)
“Nowadays, the advanced technology can help the students to learn maths independently without just depending on teachers. But currently with advanced technology, students can learn the solutions from Youtube, a lot of people post the solution in Youtube, so we should use the advantages of advanced technology. If the students put an effort to solve math questions still can be done without their teachers.” (P3)

4.6.6 (b) Senior assistants’ perspective

According to the majority of the senior assistants responses showed that all the CIHSs provided sufficient teaching aids but the utilization level still questionable. Most of the senior assistants still concern about academic achievement in UEC result rather than learning process. CIHSs are very much examination oriented until senior assistants only focus on teachers’ PCK competency in improving examination results. The following verbatim interview records are supported the theme:

“Some teachers used different teaching aids to teach different topics. Generally, I see most of them like to use different color to highlight the important points. Some used different marker pen to show the sequence of the formula. Most of the teachers used multimedia teaching aids. School has invested a lot of money in purchasing software. This kind of software particularly useful when teachers need to teach 3D, geometry, or graph lessons because they don’t need to draw.” (SA1)

“Dong Zong has produced a book which including all the past year questions according to the topic and form. Let say junior Year 1, teachers will practice the past year questions in junior Year 1. I find this book is very good. We want all the students bought that book so that it can be one of our teaching aids.” (SA4)
4.6.6 (c) Mathematics department heads’ perspective

Most of the mathematics department heads emphasized that using teaching aids at senior secondary education level is not a necessity rather than using guidelines and challenging questions to practice their students are found to be more meaningful than using attractive power point presentation.

“In School A, we have a standard type of questions accumulated in the book. Sometimes I will add in extra questions in instead of just use the standardized book to good students. This book is we created together with my team members. I think in the near future, we have to make some amendments, this book we made it last year.” (DH1)

“There are many reasons they are not practiced what they learned from New Era College in the classroom. Firstly time constraints, like Senior UEC syllabus is tough and broad, if teacher want to use video or ppt to the class, can teacher covers all the syllabus on time or not. So teacher may not want to spend their time to look for various methods for example attractive ppt or video to attract students’ attention, they just want to finish their syllabus. Besides, from my experience, especially exam class students they did not prefer teacher to use ppt to teach rather than using chalk and talk. If I use video or ppt, students will tell me teacher is wasting the time, we have watched the monitor screen so much already, feel bored, better cover more in our syllabus.” (DH1)

“My solution to the weak students who are not interest in math is giving them simple questions. They are not interested because some maths questions are too difficult to them. Sometimes difficult topic for example calculus, I will use animation to help them understand. Some software we bought from China will help students to understand better by showing them.” (DH3)

“Students always faced problem in this topic, sine, cosine and tangent, I do not know why they are confused between angle and degree. Our professional learning community activities are including CK and PCK. Our math teachers always use different PCK in their teaching. I always advise teachers to get new knowledge in preparing ppt and other teaching aids. We have reflection on teaching annually for
Math is a lively subject, so cannot depend on memorize to study math. My style is like my students to argue with me for the questions that we want to solve. You have to make your math class fun then students only like to learn maths. Or else, it is not working.” (DH4)

4.6.6 (d) Mathematics teachers’ perspective

From the responses showed that all the mathematics teachers are capable in using advanced technological tools and soft wares to assist them to teach in the classroom. Besides, all the CIHSs except School D and E are equipped with high technology facilities such as visualizer, LCD projector, Smartboard and others.

“If I teach something abstract, I will find something concrete that we have in the class to let them understand better.” (T3)

“We have sufficient teaching aids, advanced technological tool such as LCD projector and other related material. We used software together with demonstration.” (T7)

“Using technology for example visualizer save our time do not need to hand copy the questions just last time.” (T7)

“Generally, I do not have problems in my class. Students like math and they are very proactive and concentrate on their learning. Regarding the change of UEC exam format, I just need to tell them about the change, make adjustments on the questions, not much problem. If I teach about graph, I will find software to assist in my teaching. This kind of software is really helpful. I do the same as T7, I also require good students as my small teachers as well as individual teaching to help the weak students. But some of my students send their mathematical problems to my facebook seeking my help to solve the math questions that they do not know how to do.” (T8)

Normally, I give more easy questions to the weak students so that they have confidence. My class is a weak class JK4, the whole class will fail if I don’t do
anything. So I have to use some stories to explain to them. They are different from good class, I have to use my own skills not like handling good class, I cannot straight away teach the lesson. Need to develop their confidence, if I scold them also not effective, they feel annoyed.” (T12)

4.6.7 Classroom management of mathematics teachers

4.6.7 (a) Principals’ perspective

Most of the principals agreed that classroom management competency is one of the most important elements in PCK. They are willing to help the new teachers to improve their PCK in terms of classroom management. This competency is a significant factor for teachers to produce effective teaching process.

“Normally new teachers are not good in classroom management. Most of the time, I will check on them but students will well behaved once they saw me. Sometimes I will ask my students about the teachers whether they can understand her teaching or not. Normally I will ask the new teacher after a month whether she has problem to manage the class or not. I will share my ideas with her. If teacher wants to keep the problem by herself, she will lose.” (P4)

“Mathematics teachers who have problems in classroom management in this school are not many.” (P3)

“Those teachers who are facing problems in classroom management would seek for help from the principals. However, all the classroom management problems cannot be detected through classroom observation. This is because students will cooperate very well with their teachers because of the principal’s appearance.” (P5)
4.6.7 (b) Senior assistants’ perspective

Majority of the senior assistants highlighted that classroom management competency is more needed for the large class size compared to a small class size. Besides, classroom management competency is not so much needed in girl school. The following verbatim interview records are supported the theme:

“For the teacher who received complain from student or parents, I will check the teacher time table, and go to observe her teaching. First of all, I will observe the surrounding. I will see how she did her classroom management. If classroom cannot be managed, teacher cannot teach because teaching is communication with students. I want to know where is the problem, is she cannot manage the classroom or her teaching has problems. After that I will discuss with her head department. I also see whether she can interact with students. I suggested to her for improvement, some teachers can accept but some cannot.” (SA1)

“Because of the class size is quite big in this school, about 45 students each class, so teacher has to use the abilities to control the class. Of course, classroom management is a challenge to them. Experienced teacher normally don’t have problem to manage the class but new teacher has to learn and adjust so that she has managed the class.” (SA2)

“Because of School D is a girl school, we do not have much problems, somehow they are not that aggressive. I find that if students are concerned about their study, normally classroom management will be easier to control. Students pay attention, they sacred of miss out your important points.” (SA4)

4.6.7 (c) Mathematics department heads’ perspective

Most of the mathematics department heads pointed out that new teachers are challenged with their classroom management competency. To them, classroom management is the vital factor that influencing their teaching process. School B provides
six-months of probation period for new teachers to learn from experienced teachers’ PCK.

“In school, every Saturday, we have small group meeting, at that time, we will discuss about teaching problems, teaching methods. At one time, we have a few teachers who prepared their lesson and discuss together. New teachers at the first six months we required them to observe experienced teachers’ teaching. I as head department I will observe them teaching. Classroom control is their major problem. Control class is their major problem. Classroom control is their challenge, if they can overcome it, normally do not have much problem after this.” (DH2)

“For me, control class is very important to teacher to have effective teaching. I have experienced many new teachers really have problems to control class. So I always teach them to be flexible and see the situation.” (DH4)

4.6.7 (d) Mathematics teachers’ perspective

All the mathematics teachers seemed to be no problem in their classroom management competency. They know how to utilize the good students to help to teach the weak students. Sometimes, teachers have to face with talkative students.

“Until now, we still cannot find the most suitable method to teach our students in this trigonometry topic. Sometimes diagram can help them to understand a little bit better. The gap in between students at the same class because our class is quite big size about 40 students, so the gap is quite broad. Normally we will use the method suitable for moderate students. Only the questions are at different difficulty level.” (T5)

“I divided my students into eight groups. The group leader will be the excellent student so that they can help their team members who are facing problems. Some students use different way of solutions, I will make clarification on the different method used by students and compared to the method suggested by me.” (T9)
“My style is normally I do not like my students are discussing when I am teaching I am quite strict in discipline. If they want to discuss have to be after class. If they have any question to ask me must put up their hand and ask but not discuss with their friends and I will stop to explain.” (T9)

“Most of classroom management problem in girl school is they are very talkative especially for those who are not interested in math even worse if they are in the junior class. Teacher speak one sentence, they can speak over 10 sentences.” (T10)

“I can become their teacher and friend but just what has been mentioned by SA5 before, we must have some border line.” (T10)

4.6.8 Assessment of students’ performance competency

4.6.8 (a) Principals’ perspective

All the five CIHSs are having two minor test and two major examinations, make up of four assessments annually. Most of the principals give flexibilities and trust to their mathematics teachers to set assessments. They found their mathematics teachers do not have problems in this competency with the department heads’ assistance.

“School has four times exam per year. Teachers can modify questions from reference book but not allowed to photocopy directly from a reference book without making any modification. After they set up the questions, exam paper will set to head department for checking.” (P3)

“We have four times exam (one minor one major, one minor one major). In between, math teachers also give some short tests. Teachers will decide their turn to prepare exam during the research team meeting. I encourage teachers to design themselves the questions using the exam format. However, sometimes teachers are constraint of time, they copy from past year questions but change the figure. I also advised them to set exam questions properly because our exam paper will exchange with other schools, teachers must serious in preparing quality examination paper don’t let
people look down on them. Those teachers who have their tuition class, I remind them about not to leak questions to their tuition students or else they will be punished.” (P2)

“Recently senior UEC exam format has changed, my head department has to find out the changes, having meeting with all her staff, work as a team. I always trust my teachers to carry out their responsibilities.” (P3)

“The school assessment, my observations show that teachers start with formative assessment, that is after finished each chapter, teachers have to give formative assessment, they are accounted in the overall assessment. We have two minor tests and two major exams, however new teachers are not involved in setting questions for tests or exam, this is fair to students. My head department will identify who supposed to set questions. Normally each teacher will have to set two times a year. Everything is recorded and we are very professional. By referring to this record, I know who is the one who set the exam questions and the scope of the exams as well.” (P1)

“After the exam, teachers have to key in their students’ marks into computer and analyze it. Our passing mark is 60 percent. If students cannot pass, it shows that teachers do not have effective teaching. I want to see students gradually improve, if not I ask the teachers to do their reflection on their teaching method. This year, I start to check on how teachers mark their exam papers. I randomly choose three from each group: good, moderate, and weak. I want to see whether teachers follow the marking scheme to mark or not.” (P1)

“Most of the assessments in School E are better to let the students completed in the classroom than bringing back home. One of the reason is the students’ quality is not so good and most of them would like to copy rather than do it by themselves. Therefore, I allowed my teachers to give less assignment but to make sure students understand and do it by themselves. Most of the students could not finish their assignment because they are addicted to games.” (P5)
4.6.8 (b)  Senior assistants’ perspective

Generally, the senior assistants are satisfied with their mathematics teachers’ assessment of students’ performance competency. They noticed that all the mathematics teachers are following the assessment process closely. Some senior assistants (SA1 and SA4) have set their own rules and regulation to control and develop this PCK competency.

“Although school requires all the subject teachers analyze their exam results and explain clearly their students’ performance. I found that some teachers did a very detail analysis which identifying percentage of students in each grade, the difficulty level for each question but some teachers just provide a very brief analysis. Their exam analysis will be checked by school administrators and some parents may question on their children performance. Based on the analysis, school administrator will request the teachers to explain if the students’ performance is deteriorating. Some teachers will reconsider their teaching method and make adjustments after the exam.” (SA1)

“We have two major and two minor internal exams. Minor exam will be more simple and covers only the topics that have taught over the three months but major exam will follow UEC format to test the students. Our UEC performance every year shows a gradually improvement. This is because of our teachers had been worked hard in their teaching.” (SA2)

“Teacher who set the exam questions will submit to head department for checking. After confirmed that there is no error or no unclear statements then only proceed to printing. After the exam, we analyze the exam results according to the score and percentage.” (SA2)

“The change of exam format started from last year, we are informed and make some adjustment. Most of the problems or changes, math committee meeting discussed from time to time.” (SA2)
“In setting exam paper, we have to modify questions, cannot copy exactly the same as in the reference book. I fix that all math teacher must use at least three reference books to refer when they set exam questions. For example we have four maths teachers who taught senior secondary Year 3, we have to sit down and discuss together to prepare lesson and identify who set the exam.” (SA4)

“To me, our teachers’ PCK and the UEC syllabus are quite matched if I see from the results because UEC is the national standard exam. At beginning when I started to work here, the percentage of UEC was just 20 percentage but now has been gradually moving to our target as 60%, Junior UEC most of time can reach the target but Senior UEC still a little bit difficult, but it is progressing. We must understand every year we received different kinds of weak students, their weak levels are something that you cannot imagine, yet teachers can keep on the improvements in the public UEC exam, it can be proved the PCK competency of our teachers.” (SA5)

4.6.8 (c) Mathematics department heads’ perspective

All the five CIHSs have followed the proper procedure of implementing the school assessment to measure students’ performance. All mathematics department heads highly emphasized on the importance of doing UEC past year questions to improve students’ learning abilities and outcomes. They strongly believed that the more practices and revisions have been helped the students to the better performances.

“Question bank? Yes in School A also have as my previous CIHS in Perak. All the exam papers will be collected by math head department and then submit to administrative affair leader and put them in e-class. Any of the students can access to e-class to see the exam papers for all the past years including the answers. This is a very good system.” (DH1)

“Math teachers are required to finish at least 10 years of the past year questions. We must complete all the senior UEC Year 3 syllabus by the first half of the year, then we will start to do revision on past year questions according to topic from Year 1, Year 2, and Year 3.” (DH1)
“Internal exam standard still cannot be the same standard as UEC that set by Dong Zong. The UEC standard is more professional. If our internal exam want to follow Dong Zong standard, students are impossible to pass. Majority of my students not yet master the skills as high as Dong Zong’s expectation. Only a small number of students who can reach Dong Zong standard. However, I do not do analysis how many percent. It depends on the seriousness of students. They know that it is internal exam, but when they come to the Year 3, you can see a big difference than the previous years.” (DH2)

“Last year Dong Zong change the format, previously the science stream student will have applied math 1 and applied math 2, the normal class will have applied math and general math. The applied math 1 on science stream is the same as applied math in normal class, only the coverage different but start from last year the two exams are different and the applied math 1 for science stream is more difficult. We were not informed about how the change would be, now at least we have last year example to refer. The whole country on applied math 1 was dropped seriously last year. For the past, if student have tried the past year questions for 5 years, basically they can familiar with the exam style but last year they totally do not have reference. A few years later, we will know better about the question style when more and more past year questions that we can refer. I always do analysis on the UEC exam questions topic allocation to know about the focus, then I will let my teachers and students know.” (DH2)

“I did not require my math teachers must do the past year questions. But I myself will do. I did not determine how many years of past year questions students must finish. There is no limit for them, ask them to do as many as possible. I photocopy the past year questions box by box. Each year 2 sets, 1 set is for them to do as exercise, I will tell them for example tomorrow will test them past year questions 2016, up to them whether they try out or not. Let it be assessment to students.” (DH2)

“We will clear all the syllabus for the first half year that is 6 months, after that just practice non-stop for the past year questions. Past year questions is extremely helpful. Although seem to be followed blindly but when they do a lot, students start to understand the difference with questions in text book including the time control during the exam seem to be improved. For example, multiple choice 20 questions, students have to finish within one hour. So if I have two periods is about one and a half hours, students have already known which year the past year questions will
have to do, so I limit 45 minutes to finish because the questions they already known. At real exam, the questions are going to ask, they do not know. 45 minutes for 20 questions, they must use to it that one question allows for 3 minutes. My method is let them train themselves with the past year questions and only test them with the same questions, to train them the speed of answering questions. Some teachers do not do the same style as mine, they do not let the students know which year of past year will be asked, they photocopy and test the students with that particular year questions.” (DH2)

“Oh no, I do not have time to analyze which parts of questions that most students cannot do. Dong Zong provided the answer scheme for their past year questions. For the subjective questions, there are more than one method to solve the same problem, so the model answers have given them all the methods that they can use. Teachers only need to explain to them related to multiple choices, because answer is A, B, C but they do not know how to get the given answer A. For the subjective, unless all the three methods provided, students also do not understand then only I explain to them.” (DH2)

“Assessment system in School C, we have two minor and two major tests per year. The teachers who are teaching the same form will check first after the teacher has set the exam questions. After checking by the same form maths teachers, the exam questions only forward to head department to evaluate. After this, the exam paper will be sent for printing. In other words, all the exam papers are going through two cycles of checking. Although we did not explicitly mentioned regarding how many reference books teacher should use to refer and copy the questions to set exam questions, but all the teachers seem to understand. Generally they will copy the exam questions from several reference books not only one book. I understand that it is quite difficult to require teachers to design their own questions in the exam papers. So far, never happen before that teacher straight away takes from the model questions from the market to set the exam papers although we did not mention about this.” (DH3)

“Minor test will be all multiple choices questions but major test has multiple choices and subjective questions. This is set by the previous head department. Mainly all multiple choices questions in minor test is to reduce the teachers workload, easy for teachers to mark and also minor test just to let teachers know about the extent of students mastering level. The time also not long only 70 min so if we give them subjective questions, they need more time.” (DH3)
“The roles of exam are important to decide the method that we teach. Exam results are reflecting teacher effective teaching. For example if my students passing percentage just 40 percent, teachers have to adjust their teaching method. We have so many classes, so we cannot because of some weak classes to affect the progress of learning. So the syllabus that should focus has to cover no matter how slow is the learner. What we can do is giving them simple questions. So the teacher who set question needs to consider about the difficulty level of the exam questions. Generally there will be about 40% of the exam questions will be the easy one. If the weak students can do it, is ok already. The ratio in exam paper we determine as 5:3:2 that is easy 50%, moderate 30% and 20% hard questions.” (DH3)

“After the exam, all the teachers will do their own analysis, no need to send to me. We have done our adjustment between us informally. Only the school open day, while the parents are invited to visit the school to know about the students’ progress, form teachers will do the overall analysis not the subject teacher.” (DH3)

“Other than observation to new teachers, I also look into their exam questions, the results of their exam. If the exam result is poor, I will have to look into what is the problem. We always discuss together and share most of the experience together in non-formal professional development but we do not have team teaching. But we have two maths teachers for a class, one teacher in charge of certain topics while another teacher in charge of the other topic.” (DH4)

“Actually teachers faced two major problems, one is lesson speed, because teacher must cover the topic that included in exam, the other is students not yet master the topic, you have to reteach. So sometimes I ask the teacher to set the exam separately because we are not using the exam score to streaming students but teachers normally do not want to set separately because workload.” (DH4)

“Exam questions will be checked by me. I require teachers to bring the previous lesson 30% to the exam questions and 70% is related to current topic. For example the first 3 month test in senior secondary Year 1, teacher has to take 30% of the related from junior secondary Year 3 to this exam. 20 to 40% are multiple choices questions and 60 to 80% are subjective. Of course I did not expect my teachers to design their exam questions but they must do some modification on the questions
that they adopt Math subject is quite complicated in this school because each class especially science class they learned 3 math subjects. Most of the class would attend more than one types of math.” (DH4)

“Actually my math teachers are very excellent. Most of their exam questions are quite ok. I have a few problems like one teacher set one question for 20 marks, so if the students do not know how to do will fail straight way. Another one who refers to only one book to set all the questions. These are just a few cases that happened. Most of them do not have a problem.” (DH4)

“That students do not want to do homework, this school uses the method of asking the students to stay back. The written formative assessment normally will use to measure students’ understanding. Most of the questions, we use two methods sometimes we design ourselves sometimes we can refer to reference exercise book to set the exam questions.” (DH5)

4.6.8 (d) Mathematics teachers’ perspective

All the mathematics teachers strongly believed that UEC past year questions practices and revisions are extremely important to upgrade their students’ academic achievement. They have to spend more time to guide weak students with the condition weak students must not copy from their friends and they have to do it by themselves even though with less questions and more simple questions.

“All the while in this school, I am teaching exam classes. My principle is good students we hope that they can get good result as A but weak students we try to help so that they can at least pass. To my opinion, past year questions are very important to students. The more they do, the better they will be. Normally I will finish my syllabus between July to August, I have about 3 months period for them to do past year questions. At first, I will ask them to complete the recent 3 year past year questions. Those students do not know how to do, must ask. After a week for them to practice the 3 years of past year questions, I will give an assessment, randomly choose those questions from these 3 years without doing any modification. From this assessment I will know those students who cannot cope.” (T3)
“Questions in UEC text book must let the students do it. We have limited reference books. Teachers have to do their own research on the past year questions to get the pattern of the questions. This work is very challenging.” (T3)

“PCK has to be different to different level of students. I have to say that my PCK still very much concern on the UEC exam. Last time I have better students than now, so they practice more questions than the current students. I have no choice, if you give them more, they cannot do it also no point I try to narrow the scope as well. For example last time I use multiple choices questions and subjective questions together. Now I use multiple choices questions first, let them understand then only go for subjective questions.” (T3)

“School exam questions, we will modify according to UEC format, but we redesign and modify in our internal exam. We ask students to do a lot of past year questions, depend on the capability of the class, but at least five years of past year questions students have to do. Depend on individual capacity, average 3 to 5 years past year questions, students have to do.” (T5)

“Good class average 70 percent to 80 percent depend on the difficulty of questions but weak class sometimes 10%, even can get 0% of student who can pass. Weak class can get 30% consider as very good.” (T6)

“Actually the exam format change is still ok. But students have to control the time because they have to answer 12 questions now. Weak students need confidence. Normally we need to simplify the questions so that they have confidence to do it.” (T7)

“This school we do streaming the classes, for example we have 14 classes for one form, 3 or 4 classes will be at the same level. The last 3 classes are comparatively weak. So we give simple questions first then followed by hard questions.” (T7)

“We set our target at the beginning of the year related to who set the exam questions. The weekly meetings help us to ensure we are not out of the track.
Actually we are very friendly, we try our best to help each other. Sometimes we message to our colleagues if we face any difficulty. We have to encourage students to try, giving motivation to them.” (T7)

“What I do is I have small teacher, let the friend help them first. If cannot only seek help from teacher. The gap between the students in the same class is not broad. Of course, some weak students may still stuck so I will give more attention to these few weak students from time to time. Normally after finish one topic we will give formative assessment but sometimes too busy, two topics done only have assessment.” (T7)

“Formative assessment is good because both teacher and students know about the progress level. For excellent students, I will give them more challenging questions.” (T7)

“The UEC exam format has been changed since last year. Although senior UEC applied math are very difficult, it depend on students’ capability. Good students do not have problems. Different level of difficulty provided to the different level of cleverness of students.” (T9)

“Start from this year, I have set up facebook group for my math class. If formative assessment, I upload those correction versions to show to them what are their mistakes. I also upload notes in the facebook so that we do not have to waste time to copy during class.” (T9)

“I always let my exam class senior secondary UEC Year 3 practicing a lot of past years questions. This method can help my students to familiar with the technique of questioning in past year questions. I have integrated all the past year questions in our formative assessment after I finished one topic, and also in our daily exercise, in test papers or exam papers.” (T10)

“In CIHS, we do not have many reference books that we can refer. Sometimes I used the PMR questions which are quite similar to junior UEC questions for assessment.” (T13)
“Most of our students are average, usually when I finished one topic, if have 8 questions, I will let my students do half of them. For good students, they will have to do all the 8 questions. For weak students, I will let them do in the class. I feel that practice is important. I must make sure my students practice according to their level.” (T13)

4.6.9 Students’ perspective on PCK of their mathematics teachers

Researcher used singular question to ask about students’ feelings towards their mathematics teachers’ PCK not their opinions or value questions because they are not mature enough to provide their opinions according to the themes. As a result, researcher synthesized the students’ feeling in their learning process that related to their mathematics teachers’ PCK. Generally, all the 27 students indicated that various methods have been used by their mathematics teachers to teach and assess them. Mathematics teacher also are found to be consistent in their performance with or without administrators’ supervision. Most of the students seek for help from their friends first before referring to their teachers. Generally, most of the mathematics teachers used various methods and teaching aids to assist students in their studies. Most of the students are able to approach their teachers through technological communication WhatsApp messenger. Almost all of the students agreed that past years questions are more difficult than internal examinations and are the most effective way of learning mathematics subject is through practicing. Students’ opinions are in line with their teachers’ views.
4.6.9 (a) School A

‘Small teacher approach’ seems to be a popular method used in School A. Only three students out of the five are attending mathematics tuition class. Extra class which is conducted by School A is a compulsory event. All the students mentioned that they could understand very well each topic when it was taught separately, but when teachers linked several topics and formulas together during the examination, they started to confuse and could not answer the questions correctly. They also confused with the questions although the format or style is the same as past year of UEC examination questions.

“Teacher taught us small part, part by part then combined all the small parts to form the total solution. I find that this way is very effective, because most of our problem is we do not know how to combine altogether, link the related formula even though we have understood already all the small parts.” (S5)

“I find that teacher used a few methods to solve the same problem. Teacher will start with a simple method first then gradually to the complex one. So we learn how to use several methods to solve. I find math is very interesting and understand better when we try a few methods.” (S1)

“I find that teacher use a long method to solve the problem first then followed by a simple one, we can choose either one from two methods but understand both methods.” (S3)

“When I was taught by my friend I find that was better than teacher. This is because teacher knew very well the whole problem, she overlooked a small part of the whole question, and that small part was the key point that caused us could not solve the problem. Friend is different because we are the same at the beginning, but my friend can notice the small part that I don’t understand, once he highlighted it, I straight away can solve the question.” (S4)
“Some parts that we learned before I have forgotten but once remind by my friend, I will realize my mistake.” (S5)

“I have tuition with my own math teacher in school. The difference is at tuition class, teacher does the summary, teaching method still the same. In class exercises are given from the text book but in tuition class, exercise given from past year questions.” (S5)

“In tuition class, we can ask questions but in class if we do that it may slow down the progress of learning.” (S4)

“Teacher will give more guidance to those weak students.” (S4)

“Our exam questions are quite difficult, most of us cannot get good grade. In UEC exam, the grading is depending on the difficulty level of the exam questions. For example, if the exam questions are difficult, 60% can get A already.” (S1)

“Exam questions and exercises that we do daily are very much different. It linked several topics together.” (S2)

“Because of this year is the exam year, teacher do not have time for group teaching.” (S3)

“Once completed one topic, teacher will give us assessment.” (S2)

“Format of assessment and exam is the same, but the exam has higher difficulty.” (S1)

4.6.9 (b) School B

Generally, all the five students (S6 to S10) can get 80 to 90 marks in their internal examinations. These S6 to S10 have helped their friends who are weak in mathematics.
“Every time teacher only uses white board.” (S6)

“Internal major exam normally is more difficult than minor exam.” (S7)

“Major exam format is the same as UEC past year format but teacher did some modification Minor exam is not the same as past year questions.” (S8)

“Teacher did not give different questions or special guidance to our friends who are weak in math.” (S10)

“The weak friends will borrow from us the exercises that teacher gave but they ask us before copy.” (S9)

Majority of the students found that they are hard to relate the teacher’s PCK in solving mathematical problems.

“In senior secondary Year 3 math, what the teacher demonstrates to us is the exemplar questions and let us do the questions in the text book However what he demonstrates the question is not very closely with the questions that he gives to us. That is why we have to struggle by ourselves to get the solution.” (S6)

“We do past year questions to prepare ourselves for the major exams but must practice regularly not the night before the exam. If like that, for sure we will fail. Everyday I spent at least one hour on math.” (S7)

“I spent more than him, about 2 to 3 hours.” (S8)

“I try to finish all the exercise but still hard to cope.” (S9)

“At least one hour, or whenever I am free.” (S10)
“I am not consistent, sometimes I do math sometimes not.” (S6)

In School B, teachers are not using diverse methods of teaching.

“Teacher only use classroom teaching, never use group teaching or individual teaching.” (S10)

“No, my class has 29, 42, 45, 35 students” (S7, S8, S9, and S10)

“Although the class size is big, as long as we ask teacher, teacher will help us, so I don't feel that I have less opportunities.” (S10)

“Teacher gives enough concentration on us.” (S8)

4.6.9 (c) School C

Students found that their teachers have explained in details using a simple method to make them understand. However, students have their own ways to solve their problems such as think by themselves, asking their friends or teachers. Students revealed that their mathematics teachers have used diverse strategies to make them understand the contents of each topic.

“...because teacher explain the math question in a simple way, make me curious want to know more.” (S13)

“...think by myself” (S14)

“...ask friends” (S11)
“...friends also don’t know, I will ask teachers.” (S15)

“Teacher’s method sometimes is different from friends.” (S12)

“I can easily understand my friend’s method than my teacher’s method.” (S13)

“Sometimes I listen to my teacher’s explanation, I miss up one step, so when my friend explain to me, I straight away understand it.” (S14)

“I found the most difficult topic is statistics in Year 2.” (S15)

“Whenever there is a new topic, I feel difficult. But after teacher explains for a few times and gives examples, I start to feel not so difficult.” (S11)

“Normally, teacher will start with examples, use some daily examples to explain.” (S14)

“He always used different methods to teach us.” (S12)

“Sometimes my friends come up with the different method but not sure about the method is correct or not, so we will ask teacher to confirm.” (S13)

“Teacher used the visualizer and white board to teach, smart board and some software like geometry is very helpful to our understanding. Such as visualizer is very helpful while teacher is teaching graph.” (S15)

“It depends on the topic, some topic if use technological teaching aids help a lot, but some we want my teacher to use the white board.” (S12)
“When we start a new topic, a new formula, we feel not confident and difficult at the beginning, but after we practice we will get familiar.” (S13)

“Teacher sometimes helps us to memorize formula by using some interesting method like: $\sin^2 + \cos^2 = 1$ is strawberry + chocolate = ice-cream.” (S15)

School C has two major examinations and two minor examination. The duration of minor examination just 70 minutes with 25 multiple choices questions. In other word, each question weighs four marks. However, major examination has subjective and multiple choices questions. Majority of the students found that major examination is considered to be more reliable to measure their mathematical abilities.

“I feel that major examination can really measure about our math abilities.” (S11)

“All of us can score A for most of the internal major exams, but minor exams sometimes cannot. For example, minor exam one question wrong lost 4 marks, not easy to get A.” (S15)

The following are a few methods how students approach their mathematics teachers while they are facing problems.

“If teacher does not have the following class, he will explain to us straight away, if not he will write down, and explain to us for the next lesson.” (S12)

“Our class has 37 students, but we do not feel that our development is restricted by the big size of the class.” (S11)
“His classroom management is very good. We are all very quiet when he is teaching.” (S13)

“He has all our record.” (S14)

“We have a Whatapp group, sometimes the mistakes that we did, teacher took the photo to show to us.” (S15)

“Sometimes he also solved the math problem through Whatapp.” (S11)

“Teacher even snaped all of our mistakes in the Whatapp, then we realized about our mistake.” (S12)

“The photo did not have our names on it, so we just know the one that belong to ourselves only.” (S11)

“The final exam questions difficult are not so difficult. Most of the questions we have learned in the class.” (S11)

“There are a few quite challenging questions that need us to think by ourselves. And we have to use various ways to solve.” (S14)

Teachers utilized the past year questions in various situations:

“Sometimes at the beginning of the topic, teacher demonstrates with past year questions.” (S11)

“Sometimes at the end of the topic, teacher asks us to solve all the past year questions that related to the topic.” (S13)
“Past year questions are more challenging compared to questions in text book.” (S12)

“Our teacher always reminds us if we do not know must ask him or your friends, do not accumulate your problems. Don’t ask those who don’t know.” (S12)

“If we have problems, we will ask friends first before ask our teacher.” (S11)

4.6.9 (d) School D

Teachers are found to use different methods to teach most of the times indicating that teachers possessed PCK.

“Yes, for example, memorize the formula, she will create a poem for us so that we can easily remember the formula.” (S18)

“Yes, my teacher said don’t need to use the methods in the text book, we can use other methods.” (S16)

“Yes, my math teacher is very experienced teacher, sometimes we need to use time to think about it but she doesn’t need to think at all.” (S17)

“Every class has smart board. But math teacher likes to use white board to explain. Only certain questions that she did not photocopy only she used smart board.” (S16)

School D has average 4 times of examinations per year. Teachers utilized various methods to help students in solving mathematical questions.
“Our school has 3 times internal exams, but if including the public exam will be 4 times. So I am in senior secondary Year 3, I will have 4 times exams for this year.” (S18)

“We are in senior secondary Year 2, so we have 3 times exam for this year. But we have trial SPM, so we also have 4 times.” (S16)

“Our math teacher gave us her phone number. If we face any difficulty in math, no matter at home or in school, we use Whatapp to ask her, she will reply to us. Or sometimes during recess, we can go and see her.” (S18, S19 and S20)

“If teacher feels that most of the students cannot understand that question, she will explain to the whole class for a few times. But if only one student cannot understand, teacher will make an appointment with that student and teach her after class. Or she may slow down the speed to explain more details, but she will not because of one student and slow down the progress of the whole class.” (S20)

“I find that the exam questions and the past year questions is not much different.” (S18)

“When teacher taught us a particular topic, she will pick up those related past year questions for us to do. Applied math has 2 papers. Paper 1 for the past year, we have almost done. But paper 2, some topics not yet covered, so we not yet finished doing the past year questions.” (S18)

“Because we are going to take SPM this year, so our teacher seldom gives us UEC past year questions to do. She gives more questions related to SPM and our textbook exercise questions.” (S16 and S17)

“We are learning 3 types of math, including 2 UEC math and 1 SPM. UEC math is more difficult than SPM so if we can do UEC questions definitely we can do SPM questions. Our English proficiency is more than enough for us to handle SPM math in English.” (S17)
4.6.9 (e) School E

All the students (S21 to S27) were satisfied with their mathematics teachers’ PCK and they can understand very well.

“*At least he used different teaching methods to let us understand.*” (S21)

“He can teach me until I understand.” (S26)

“...use interesting methods to explain to us. Teacher always relates math to something else so I feel interesting.” (S23)

All the students (S21 to S27) said that teacher's PCK is the same even though principal or senior assistant came into the class to observe their teacher. S22 and S25 mentioned that mathematics teachers used different methods for different topics.

“For example, when teacher taught us about ‘distance’ topic, he used our seats distance to explain. I find it is effective.” (S25)

“Some formulas very complicated, teacher can simplify it until we can easily remember.” (S22)

All the students (S21 to S27) agreed that teacher provided ample of opportunities for them to practice mathematical questions. All the students from School E confirmed that their mathematics teachers do not have any problems in terms of their PCK.

“Every day we do at least 7 to 8 questions.” (S25)
“After we finished a topic, he will let us do the exercise.” (S26)

“More than half of the questions in the text book we have done.” (S23)

All the students (S21 to S27) revealed that their teachers’ teaching methods are different from their friend’s teaching methods. Majority of the students said that their teachers’ methods usually are clearer than their friends but their friend’s methods sometimes faster than their teachers to get the answer.

Majority of the students indicated that exercise questions are generally easier compared to examination questions. However, they are able to do the examination questions if they practice their exercise questions very often. Moreover, examination questions are set by different teacher and covered a few topics so the examination questions sometimes more difficult. According to them, they will able to solve the problems through practicing.

All the 7 students allocated different time length to do their mathematics questions.

“Yes, I do a lot of exercise questions every day so I spent a lot of time on math.” (S21)

“Every day I practice to solve the homework given by teacher.” (S23)

“I spent about 70% of my total learning time on math.” (S22 and S24)
“I spent about 50% of my total learning time on math.” (S21, S25 and S26)

“I spent about 45% of my total learning time on math.” (S23)

“I spent about 30% of my total learning time on math.” (S27)

Out of the seven students, only one student attends private tuition class. The other six students said that school teachers have taught them very well, they can master enough knowledge to attend to the UEC examination. S22 said that he is not good in mathematics not because of his mathematics teacher insufficient of but because of he cannot think abstractly and make the connections by himself. On the other hand, S27 cannot cope with his teacher’s speed of teaching.

“When teacher explain, I understand but when I do it by myself, I cannot find the solution.” (S22)

“Sometimes I cannot cope with the teacher speed. I am quite weak, difficult to find tuition teacher.” (S27)

4.6.10 Summary of the findings of mathematics teachers’ PCK

All the principals expected higher PCK competency compared to CK. They gave all the supports they can, for example teaching aids, training, giving advice to help their mathematics teachers to deal with weak students and classroom management. However,
principals stated that PCK is the most important competency that mathematics teachers need to possess.

Although majority of the senior assistants expected higher PCK competency but they are more concerned on teachers’ diagnostic skills and classroom management competencies compared to other elements in PCK. It can be concluded that CIHSs are quite examination oriented except School E. The elements of PCK which can improve the academic achievements in UEC will be given priority.

Findings from the mathematics department heads showed that they are engaged in their responsibilities to promote their mathematics teachers’ PCK. Basically, they agreed that mathematics teachers need to have classroom management competency, using ‘small teacher approach’, providing regular practice and doing more past year questions. These competencies are considered as key elements in PCK of mathematics teachers.

In addition, all the mathematics teachers are engaging and possessing high quality of PCK. Basically, they have the same views with their department heads. They emphasized on the importance of regular practices and must finish all the past year UEC questions to improve students’ mathematical abilities to face the UEC examination. They are competent in almost all the elements of PCK including classroom management, diagnostic skills, assessing abilities, and teaching skills.

Finally, all the 27 senior education students gave their consistent opinions regarding their mathematics teachers are very excellent in their PCK. This is reflected in several themes such as teachers used various teaching strategies, utilized Whatapp,
Facebook or Lines to solve their problems even though after school, provided sufficient practices and found the ways to help the weak students.

4.7 Pedagogical/Psychological Knowledge of Mathematic Teachers from the Perspectives of School Principals, Senior Assistants, Mathematics Department Heads, Mathematics Teachers, and Students

After a thematic analysis on the PPK from the five principals, five senior assistants, five mathematics department heads, and 13 mathematics teachers’ transcripts, three themes about what constitutes to mathematics teachers’ PPK were identified. This PPK was investigated according to the knowledge of classroom management, teaching methods, classroom assessment, students’ learning process, and individual student characteristics. Researcher synthesized the following themes in relating to mathematics teachers’ PPK as follow: (i) understanding of students’ learning behavior; (ii) understanding of students’ learning process, and (iii) understanding of individual students characteristics. Table 4.4 summarizes these three themes and the composition of each participant’s views. However, the 27 senior secondary students’ transcripts were not analyzed according to the themes but looked into their views about the mathematics teachers’ PPK holistically.

The three themes derived from PPK show that mathematics teachers’ PPK professional competence found to be more focus on understanding students’ learning behavior and learning process rather than understanding on individual student characteristics. The three themes were agreed from the four perspectives that including principals, senior assistants, department heads, and mathematics teachers themselves.
### Table 4.4 Participants’ view about what constitutes PPK of mathematics teachers

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<th>Themes of PPK</th>
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<th>Students’ learning process</th>
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Notes: P – Principal; SA – Senior assistant; DH – Mathematics department head; T – Mathematics teacher

#### 4.7.1 Understanding of students’ learning behavior

##### 4.7.1 (a) Principals’ perspective

Majority of principals admitted that the schools are facing more on learning problems than behavioral problems. They also highlighted the importance of mathematics teachers to possess PPK to handle the current generation learning culture. Lack of motivation and comfortable lives made the students have learning problems. Principals...
found that their mathematics teachers still need to improve their knowledge of understanding about students’ learning behavior.

“Regarding students’ psychology, those teachers who are not graduated from education, I am quite not confidence on their competencies to understand students’ psychology. I ask them to further study. There are three higher education institutions that they go to further their study namely USM, Open University for master or New Era College for diploma. I always advise my teachers to understand the students from the professional and counselling perspectives.” (P1)

“I always advise my teachers to slow talk to students not straight away scolding them. Parents now provide the best hand phone to their children and not controlling them, Teachers have to get to know their home situation, what they do after schools. We must always interact with them and understand them.” (P1)

“Generally, teachers may face some problems like students fall in love that affecting their study, come from broken families, parents too busy do not have time with their children. In this school, many parents are managing directors, having big business and do not have time with their children. In this school, poor family students are very few. But those who are poor can be a problem too. They are too tired with their job and neglected the children. Most of the teachers do not have this competency and time to deal with parents.” (P1)

“In this school we do not have behavioural problem, but we have learning problems. This is because nowadays, students do not have motivation to learn because they have comfortable life. Next is current parents are too follow whatever their children required. Students cannot face challenges or difficult tasks, they are not proactive and very reactive, we need to push them they cannot work independently. Therefore teachers need more this kind of competency.” (P3)

“Most of my students are having learning problems not behavioural problems. I should say general their behaviour is more than satisfactory. Students are coming from different background, therefore they have some problems in their learning. Nowadays, most of the students are very playful because they are coming from quite wealthy families do not have motivation to study.” (P2)
4.7.1 (b) Senior assistants’ perspective

According to senior assistants’ responses, mathematics teachers’ knowledge of understanding their students’ learning behavior is depending on the school size and class size. The smaller the school and class size, the higher level of understanding on students’ learning behavior would be. Some mathematics teachers are having communication skills to understand their students. Nowadays, many mathematics teachers utilize the advanced technological communication tools such as Whatapp or Facebook to close up their gap of understanding of students’ behavior.

“Before I came here just now, I met one of the math teachers. The problem that she faced is students do not listen to her instructions. This is a discipline problem. This teacher is my former student whom I found that she is lacking of communication skills with students. I require her to do some reflection about how she communicated with her teachers last time. Put herself as the student at the age of 15 or 16, how her teacher communicated with her. I cannot teach her a method but she has to learn how to deal with it because teacher is practioner who stands at the front line to face students. This is my way to develop teachers so that they can move forward excellently.” (SA1)

“Through my observation, teacher and student interaction is very close. They can even play ball together and have lunch together. All the teachers will set up their group chat in Whatapp or facebook, with this help us to transmit some announcement and important message to students. Among the math teachers they also have their own group Whatapp. Teachers normally will share their knowledge using Whatapp or help their colleagues when their colleagues are having some problems in the subject matter.” (SA2)

“I see my teachers have the PPK to handle the weak students’ behaviors which are so called as class management. I feel that teachers have to have this competency to understand their students very well. Because of weak students can have many problems such as sleeping, do not want to do homework, making noise, but if my
teachers can make them doing some homework, do not make noise, I assume that they have this kind of competency already. But if about their discipline behavioral problems, I don’t think our math teachers noticed about that unless he is the counselor. But learning behavior, I can see they handle it quite well.” (SA5)

4.7.1 (c) Mathematics department heads’ perspective

The five mathematics department heads highlighted a different views compared to principals’ and senior assistants’. To them, those mathematics teachers who are not from education background, they will not have sufficient PPK to handle their students’ learning behavior. If the mathematics teachers followed the students since Year 1, this will indirectly strengthen the understanding of that group of students’ learning behavior.

“Generally, my team teachers quite understand the students’ behavior, their readiness to face the exam. For myself I never experienced the change of math teacher for every year, I always bring up the students for 3 years. Definitely I know my students better. After the first year, I have already known about my students’ status so start from second year I will channel them to better result. Although we do the streaming, the good class is still have a few of them who are not so good. Gap is happened in every class.” (DH2)

“My academic background is not education, I was trained as engineer. My main problem is the interaction methods with students. But because of I am not from education, so I find difficulty to lead students. Students sometimes rebellious, I feel quite hard for me to handle. Different students have different character, some cannot use hard way to deal with, need to slow talk to them. Sometimes if I have many students with this kind of learning behavior issues, I found difficult to deal because we have to deal with them differently. Good and weak students, the way to deal with also different.” (DH3)

“I found that good students are quite arrogant but weak students are quite sincere. This type of handling students we cannot learn from book. Most of the time, I need to use hand-on experience to handle it.” (DH3)
“Caring to your students is one of the effective methods. For example, one of my students, he always plays games, he said he want to go for competition. He always feels sleepy and listless. But after I let him know that I care about him, now he did not sleep only lie down, at least better than before. I do not allow my students to sleep, they can sit quietly but cannot sleep.” (DH3)

“Sine cosine tangent topic is the major problem to CIHSs student. Last time I was at SMJK Chinese type secondary school, we also had the same problems. Students need to understand the logic of the formula, cannot just only follow formula in the textbook without understanding the logic why this formula is as such. Most of the students like to memory rather than understand and think in mathematically. Some students cannot think and stuck there. Most of students cannot apply what they learned if they just memorized it. Some math questions can relate to daily lives, students can easily understand but some cannot relate to their life experience.” (DH5)

“Those students who are good normally will have the characteristic that they will come forward to ask the teachers. For these excellent students, I will use other method not stated in the textbook to teach them. For those very weak students, I try many methods but sometimes really did not work.” (DH5)

4.7.1 (c) Mathematics teachers’ perspective

All the 13 teachers seemed to be no problems to deal with their students’ learning behavior partly because of they have longer time meeting with their students such as they have seven to eight periods per week and on top of that, some of them are their form teachers. They mentioned that all the students’ discipline problems still under control. Majority of them worked hard to help their students if their students have any problems in their learning. However, only T5 felt that this PPK competency is not important as mathematics teachers have to cover their syllabus, no time to understand their behavior.
“Of course, those difficult topics normally are too abstract to the students. So even though you have explained the concept to the students, they still do not understand. So I have to give examples. For weak students, I would like to spend more time in answering questions and explaining mathematical concepts. Of course, just like my colleague said, they need more practice. Students have to cooperate with us.” (T1)

“I also used the same method as T3 whereby I use Whatapp to answer their questions especially before exam. A lot of questions will throw to you until I have to tell them that only until 11pm or 12am. Or else tomorrow they do not have spirit to answer questions. I find that students need confidence so teachers should always motivate them if the student has improvement. Teachers’ motivation can help to maintain students’ momentum to study.” (T2)

“Different class has different problems. But weak class faces discipline problems the most. The first thing that teacher should solve in weak class is students like to walk around, make noise, cannot concentrate, sleep in class, etc. Discipline here still under control, students still listen to teacher, not like in Kuala Lumpur, students even scold teachers if you wake them up.” (T4)

“Most of the time, we are too busy to teach until we have no time to take care of their discipline. If we too much take care of these problematic students that will be unfair to other students.” (T5)

“Both of us teach senior secondary UEC Year 1, we have to teach two languages. English in math is not a problem students have to learn the terminology. Along the way I teach, I will do translation, not much problem. Our personal opinion is math should be taught in English better, because in university, math is taught in English.” (T4 and T6)

“It is easier to remember sin, cos radius and so on all the symbols are from English.” (T4)

“If science subjects like chemistry physic, that will be different, very difficult a lot of explanation. My opinion is science subject better taught in Mandarin. Over the
years, Dong Zong maintain the difficulty of UEC up to an international standard.” (T6)

“I like to focus on doing more exercises. I find that students need to do more exercises in math. For me because math has 8 to 9 periods per week, so meet with students almost every day, so math teachers and students normally have better relationship.” (T11)

“I have to remind my students to do homework. Normally I will check the next day whether they do their homework or not. But if they do not know how to do, I will guide them during the class. Sometimes, I like to spend my times to show them how to do.” (T13)

“I always make sure my students finished their work on the same day, do not let them leave and accumulate their homework. Because if they do not do their homework, they can not further their lesson because most of the topics are related.” (T12)

“Although I did not study psychology, but looking at my students’ eyes, I already known what they think.” (T13)

“When I teach, I know who are paying attention and who are not. I also know which students are just physically appeared in the class but mentally they are not there.” (T12)

4.7.2 Understanding of students’ learning process

4.7.2 (a) Principals’ perspective

All the principals believed that their mathematics teachers have sufficient knowledge to understand students’ learning process because the relationship between teachers and students are very close. However, they felt that this competency is extremely
important in current situation whereby parents are lacking of time to spend with their children. Students are also lacking of motivation to learn.

“Personally, I feel that CIHS students need teachers to understand their learning process more than national school students. In national schools they do not have shortage of teachers but CIHSs have these problems. CIHS does not have SOP to follow but interaction with students is a lot. Through interactions, generally teachers understand their students’ learning process very well.” (P4)

“Through my observation, personally I feel that my teachers can understand well about my students’ psychological development. This is because they have very closed relationships between teachers and students in this school. So the students’ preparation to study is sufficient.” (P2)

“Although school has set up some programs to cater for those excellent students to accelerate their improvement but they were not so successful. This is because of most of the excellent students, they are all-rounded and hardly find time to further training in these types of special programs. Another reason is this school has not many students which in turn those who are excellent also become less. However, the trend of this school seem to be getting more and more better quality students since these few years back. With the small number of students in a class, my teachers have sufficient competencies to understand students’ learning process.” (P5)

### 4.7.2 (b) Senior assistants’ perspective

Since many CIHSs are practicing ‘repeated class system’ has forced the mathematics teachers need to take an effort to understand their students’ learning process according to the responses given by senior assistants. However, most of the senior assistants believed that their mathematics teachers are doing well in this element of PPK. They did not neglected good or weak students’ learning process.

“Students have to repeat the study if they cannot exceed 50 percent of academic performance for the whole year. As long as the repeated class system is carried on
our whole system still exam-oriented, our focus still on academic performance. Most of CIHSs are applying this repeated class system. Other than exam, if the students’ behavior record below grade D or their extra-curriculum record is 0 mark that means they did not attend any extra-curriculum, they also have to repeat. The extra-curriculum assessments include their attendance, their position in the club and involvement in competition. This extra curriculum results was affecting the overall performance because it is times 3. For good students, we encouraged them to compete at national and international levels of competition. “(SA1)

“Students who have learning problem, teachers can send to discipline teacher and counselor to help them. I also observe my math teacher requires the weak students to stay back after school and teach them individually.” (SA2)

“Math in CIHSs is comparatively more difficult to national schools. Through my observation, I found that students are very proactive in learning math. Because I observed many students meet with their teachers in staff room to discuss about math problems. During holidays, I see students come to attend extra class with their teachers. Teachers and students in this school are very positive in learning math even sacrificed their holidays to study math especially to exam classes.” (SA3)

“For the benefit of teaching, the same maths teacher bring up the students from Year 1 to Year 3 will be better. But if from human perspectives, if you face the problem class for 3 years is quite suffer. For me between teacher and students is a kind of fate. Sometimes students just listen and obey to certain teachers. Sometimes students can make us very frustrated as well.” (SA4)

“The gap between students in each class is still very broad although it is the first class. Definitely if a class just have 3 to 4 students who are weak, teacher for sure spent more times to handle some problems for example did not pass up their homework but that does not mean that good students are being neglected. I always remind my teachers to take the medium level to teach, but for the good students have to give extra questions like more past year questions for them to practice. School fixed that all teachers must let the students completed 10 years of past year questions.” (SA5)
4.7.2 (c) Mathematics department heads’ perspective

The five mathematics department heads emphasized on mathematic teachers’ understanding on students’ learning process are related to their teaching strategies. School A has many international students from a few countries that causing mathematics teachers have problems to understand their different learning process. Most of the mathematics department heads agreed that the ‘follow-up system’ whereby the teachers are continually teaching the same group of students for three years will automatically improve this kind of understanding.

“Different students’ background, different problems. Especially in School A, our students are very much diversity. We have many different countries of students for example, China, Indonesia, Hong Kong, Taiwan, Nigeria, Thailand, Korea, Japan, so these international students are different quality with our locals, in their acceptance of our teaching method, mastering math skills and knowledge. Therefore in the same class, have different countries students, the way of teaching in term of explaining have to use many different ways to explain to different types of students and using different language. Even though they are in English class, they require you to explain again in Mandarin especially those international students in particular Thailand students, they are weak in English. They can understand Mandarin better than English.” (DH1)

“Most of the teachers do not have problem in this kind of competency to understand their students’ psychology. Because Senior UEC classes are taught by experienced teachers, they can handle it. New teacher will teach Junior UEC classes. For good students, other than the 10 years past year exam questions they have to finished, they also have to do some extra questions in the provided time. Their learning process is well supervised by their teachers.” (DH1)

“We have strengthen class for all senior UEC classes, divided to subject whereby I show to them how many questions from this topic come up in UEC exam paper 1 and paper 2. The strengthen class is offering to every subject. However for math, we manage them not according to their class but according to their internal exam result. So for good students we are pushing them to get A.” (DH2)
“The school system now is teacher follows the students for 3 years, so different teachers, you can see there is a difference in their exam results. Not like last time, the old system was Year 1 taught by teacher A, Year 2 by teacher B and Year 3 by teacher C. This new system is quite sometimes already, I found new system is better because teachers can understand the students’ learning process development very well.” (DH2)

“There was one year while the math teacher had resigned and left the school and the class was a good class. They have been changed many times with different teachers. That year I was very stressed, because they were Senior UEC Year 3, have to cover a broad syllabus. After I finished the Year 3 syllabus, I do revision with my students about Year 1 and Year 2 syllabus. I found that they don’t understand very well about the syllabus in the previous two year. I have to revise the Year 1 and Year 2 that is the disadvantage of changing teacher. Lucky that was the good class, finally the result come up was good.” (DH2)

“Personally, I prefer teacher follows the student for 3 years system which is better. But teacher and students’ relationship is reciprocal. If the student cannot accept the teacher, he has to suffer. But this kind of students is not many. Generally students are ok with 3 year follow-up system. Even our form teachers are also using 3 year follow-up system.” (DH2)

“Regarding interactions between math teachers and students, I always see many students come to approach their math teachers during recess. This year students are better than last year, they are more proactive. They tried out the difficult questions by themselves, if they cannot do, will come and ask me. Other than this way, students always send messenger to me if they have problem to solve the problem, just like I say just now. (DH3)

“The gap between the students in this class which I taught for 4 years is very broad. What I do is giving more guidance to the weak students. I do not have two set of questions, they are doing the same set. Good students can do on their own, weak students need teacher guidance. I give quite equal questions in term of difficulty, some questions difficult, some questions are easy. So to the good students, they still feel challenging.” (DH3)
“For your information, I do not face students who do not pass up their homework. This is because in School C, students have their homework marks, so the good class do not have problem at all, they will finish their homework. Even though they copy, they also pass up their homework. But the weak class will be different from this. Not because of the weak students don’t want to copy but they do not model answer to copy because their friends in the same class also do not know how to do, so nobody to copy. So if I give them homework and nobody pass up the next day, it shows that they do not know how to do, I will discuss with them. Then I let them copy it and pass up better than they do not do anything.” (DH3)

“I will not allow my students to copy. If they do not know, I will mark it wrong and ask them to do the correction with the correct answer. But most students like to copy rather than make corrections. Teacher’s intention is to make sure students to do corrections rather than copy. This is because when they do correction from their friends who are correct, then they will learn their mistake. But students do not understand. They also think both also copy, why not copy rather than correction. Students do not understand teacher’s motive.” (DH3)

“Another problem is our teacher, teacher must said ‘negative 1’ NOT ‘minus 1’, students can be confused. Because of the concept is wrong but many teachers who are from national school will do like that. Another example like ‘x square’ and ‘x two’ are different meaning. So the words that teacher used during teaching can bring the wrong concept to students. So if students bring up with the wrong concepts, teachers at senior secondary will have difficulty to correct them.” (DH4)

“Some teachers from national school who follow the math subject in Malay Language will pronoun ‘sine, cosine tangent’ follow the Malay language phonemes which are misleading the students. I told my teachers you cannot use the method that your lecturer used in university to your students you must put yourself as a secondary school students. I would like to thank my math team we have a very good spirit. Whatever I comment in our Whatsapp, they will consider and follow.” (DH4)

“I find that some teachers demonstrate all the steps of solutions, I think that is not correct. We have to provide our students to be more proactive and be self-regulate learning. Not just depending on teachers.” (DH4)
I feel that it is good to remain not allow using calculator because students will understand the original concept better. For me the gap between UEC exam and university level in term of math is no gap, students can easily cope with but for STPM students, it is a big gap between what they studied and the university level.” (DH5)

4.7.3 (d) Mathematics teachers’ perspective

All the 13 teachers have their own ways to understand their students’ learning process. Most of the mathematics teachers are able to utilize advanced communication technological tools like Whatapp and Wechat to interact with their students to solve their learning problems and motivate them to study. Most of them give special attentions to assist those weak students. All the mathematics teachers emphasized on giving more revision and practices can improve students’ learning process.

“Students now like to use Wechat, Whatapp, and play games until late midnight. So the next day when they come to school they feel sleepy. My class size is big about 40 plus students, not easy to control them. So what I do is force them to copy notes so that at least they learned something. When collecting back their notes, I find a great difference between good and weak students. Good student will take extra notes that teacher mentioned but weak student just take the note that teacher wrote.” (T2)

“Math is different from language subject. If students really practice sometimes can make a change and math is a very powerful subject.” (T2)

“In a class, I know very well which student is the best which student is the weakest. For the weakest one, if he can pass, that means every student can pass. So teacher has to make sure the weakest one still can cope with the particular topic and motivate this weakest student from time to time so that he can move on improvement. As I tell you towards the end, the weakest student can pass but the one before him fails, that was happened in my last year class.” (T3)
“Last year I have a group of better students. Although they also influenced by technology like games but they have their goals, almost 50% of the students know very well what they want. Last year students were doing quite well. This year I have 11 students only and most of them are staying in hostel. Although they have self-learning session at their hostel, but they have nobody to seek for help when they have problems. So what I do to them is I encourage them to send me Whatapp the math problems and I will try to answer them as soon as possible. When students ask for help, teacher react to them shows that teacher cares about them. So sometimes good technology can help us and teacher should utilize it. Last year I did not use Whatapp. The year before last year also not so good, I also used Whatapp to answer their questions. I find a lot of students Whatapp me especially during weekend. I have to answer by queuing up at Whatapp.” (T3)

“The gap between primary and secondary school is very broad. Especially junior secondary UEC Year 2 is already at SPM level. Junior Year 1 still ok, but Year 2 is already like Form 4 standard in national schools, so most of the students cannot cope. If they collapse at junior Year 2 will influence them until senior secondary UEC. I have to slow down my speed of teaching.” (T6)

“My effective teaching is I must finish early before exam. So the week before exam, I will use for revision. If I teach them until the day before the exam, do not provide them with revision, most of the students will do very badly in the exam. Because students have to study for so many subjects, therefore I need to give them time for revision.” (T6)

“Majority of the teachers follow the students from Year 1 to Year 3. The advantage is teacher knows the students’ weaknesses very well. In our school, students have to give feedback on their study, so if the feedback from students are not positive, school administration will not allow that teachers to follow the same class for 3 years. In this school, so far we do not have this problem, most of the math teachers are quite good.” (T7)

“In CIHSs the exercise that we give to students is a lot. From year 1975 questions still have. Actually our students practice a lot about two three hundred questions. The most important for math teacher is to create the students’ interest. For example,
one of my weak students shows to me he completed the exam, although not very good results, but at least have improvement." (T7)

"For those excellent students, I will encourage them to participate in competition in order to improve them. Because I have taught them 3 years already, teacher student interactions are quite good." (T8)

"Normally, I ask my students to check with the terms used at the back of textbook if there is a language difference between Mandarin UEC and English SPM particularly in math application questions. Students have to take these math exams in two different languages." (T11)

4.7.3 Understanding of individual student characteristics

4.7.3 (a) Principals’ perspective

Most of the principals considered this component of PPK is related to the teachers’ personality. So they have to take into consideration when they allocate their teachers. They believed that not all the mathematics teachers have sufficient in this component of PPK. Some mathematics teachers do not think that this is their responsibility to understand student characteristics.

"The gap between the students, some are good, moderate good, some are at the border of failure. As administrator, I try to equally distribute the good and weak classes among the teachers. Some teachers because of their personality really cannot control their emotion while handling with weak students. I also have some teachers who still can continue teaching while students are making so much noise." (P1)

"Current students have their own thinking and may want to question on a lot of their unsatisfactions. Some conservative teacher cannot accept. Of course teachers
have their wrong way of thinking and not open enough. Current teacher needs to have the PPK competency to accept the new era of our students." (P3)

4.7.3 (b) Senior assistants’ perspective

According to senior assistants, two main factors enable the mathematics teachers improve their PPK in terms of understanding student characteristics, namely close relationship and advanced technological communication tool like Whatapp.

“In School A, I find that teachers understand their students’ characteristics quite well because teachers and students relationships are very close. I dare not to say all but majority of the teachers have good relationships with students. This is because most of the time, anything happened to the students, teacher will be the first person to know. Nowadays, advanced technology makes our teachers and students set up their Whatapp group by themselves. Most of the students will share their feeling through the Whatapp so teacher will understand their students’ psychological feelings very well. Majority of our teachers are using this Whatapp facility to communicate with their students.” (SA1)

“This school is girl school and the school size is small so the relationship between teachers and students are close. However, must have the bottom line. I always make agreement with my students. We can be close only after class.” (SA4)

4.7.3 (c) Mathematics department heads’ perspective

Some mathematics department heads pointed out the difference between CIHSs in south or central compared to north. Generally, most of the mathematics department heads agreed that mathematics teachers’ understanding about student characteristics is helping to ease their teaching.
"Interaction between teacher and students in School B is very good, you can see when after school, students will come to the staff room, we are just like friends. Sometimes is too noisy until I hope that they don’t come to the staff room." (DH2)

"Compare our students with CIHSs students at central and south of peninsular Malaysia, they are not as good as them. But if compare our students with CIHSs in north, School B is considered quite high level. For good students, I will put them in a group, give them more challenging questions, provides opportunities for them to go for competition." (DH2)

"This class I have been taught for 4 years since Junior Secondary Year 1. If you ask me I know them thoroughly I dare not to say that. But each student’s character, I know quite well. But of course 40 over students, I cannot say I totally understand them. If you ask me whether I agree or not by understanding my students will help my teaching, I would say ‘Yes’, because some students do not like teacher to pay too much attention on them, this kind of students, we have to approach them personally. One example, I want to motivate one of my students, by saying that he has done a lot of work. Student replied to me this is not my handwriting. This reflects that this student does not like to have teacher attention." (DH3)

4.7.3 (d) Mathematics teachers’ perspective

Most of the mathematics teachers agreed that ‘follow-up system’ is an effective method to understand their student characteristics. Generally, students need their supports when students are facing problems. If mathematics teachers can understand better student characteristics, they can utilize the ‘small teacher approach’ as a win-win method to overcome students’ learning problems. Foreign students are weak in language which affecting their learning process. It is important for mathematics teachers to possess PPK competency by understanding their student characteristics to ease their teaching since mathematics is a difficult subject in CIHSs.
“I request the principal to let us bring up the students since Year 1. Those teachers who are teaching senior secondary Year 3 actually is quite difficult because teacher does not understand their characters. Math is a subject with explosion power. So student confidence is important. I have one student whom I start to teach him during senior secondary Year 2 from commerce class. He told me that he never passed his math exam since junior secondary. So I tell him you can do it I always ask him to carry exercise books for me. On the way to staff room, I will ask him whether he has any problem, he can understand my lesson or not. Provide assistance and support to students is important. Finally he scored two A’s for the two math subjects because he is from commerce, he did not take applied math.” (T2)

“Most of the class has leader who can lead them. So teacher can use this leader to influence the other students but not the other way round. This year I thought of one smart student can be a leader, but he fails to be leader. However, another student who is not so good would like to lead the team. He always likes me to teach him math. Sometimes math teacher must understand their psychology because when they meet with math problems, psychologically they want to solve the problem quickly so math teacher needs to understand their psychology. I have one effective method is when we can think of the problem before sleep then tomorrow morning we will know how to solve it.” (T3)

“There is a big gap between good and weak students. For me, good students become my small teachers. Because if they are able to teach, means they can answer the exam questions. Although their methods sometimes not so comprehensive, at least they have their confidence if they can teach their friends.” (T3)

School A has many foreign students and yet from many different countries. Yes, my experience with Thai students. Foreign students most of them have language problems. I teach senior secondary so I have less foreign students. Foreign students are not so good in mastering the subject basically because of the language. Foreign students can do the questions in class but their exam results not so good partly because in UEC exam, the questions are long, they cannot understand well.” (T3)
“Every class in School E is quite small size. We have average of 20 students. I am quite familiar and know very well about our students’ characters because the small number of them.” (T12)

4.7.4 Students’ perspective on PPK of their mathematics teachers

Researchers synthesized the students’ feeling in their learning process that related to their mathematics teachers’ PPK. Generally, the interaction between teachers and students can be considered as quite close between mathematics teachers and their students. This is because most of the mathematics teachers not only follow the class for three years but also are the form teachers. Mathematics subject is a core subject so there will be six to seven periods per week. Therefore, most of the mathematics teachers understand their students’ psychological characters very well.

4.7.4 (a) School A

All the five students from School A agreed that their mathematics teacher understands them quite well because he has taught them for 3 years. Most of the students in School A not only get support from their mathematics teachers but also they have their small teachers who have inspired them psychologically.

“Math let us develop our exploration feeling.” (S3)

“Even some of their gestures, teacher also can understand it and ask the student whether he understand or not.” (S1)

“Many of the students give up because they cannot follow the lesson.” (S4)
“Learning behaviour of School A students have to improve, we need the head of class to train and lead us in the class. This is because once we see other students study hard, we will get influenced.” (S5)

“There is one train leader in commerce class 1, he is from China, he is really a bookworm.” (S1)

“Although School A has many foreign students but we can interact between us because all of them can speak mandarin.” (S1)

“The top student in both classes science and commerce are from Indonesia and China respectively.” (S3)

“Our class does not have discipline problem.” (S4)

“Teacher needs to communicate with students to understand them. Parents and teachers just want to see me to get A, never try to understand me. I feel that teacher has to reflect by themselves, is academic the overall of education? How about other elements like leading, extra-curriculum, not just result! We need to have our own thinking.” (S1)

4.7.4 (b) School B

All the five students from School B have a close relationship with their mathematics teacher. They mentioned that their mathematics teachers never turn them down if they have problems. Generally, their mathematics teachers understand them very much.

“Regarding interaction with teachers, we do not have problems. If we have problems, we will go to approach our teacher in the staff room.” (S7)
“My math teacher always said “is like that”, may be he found difficult to explain to me.” (S6)

“If I try very long time still cannot solve, I will go to see the teacher, he will give us the direction on how to do it.” (S10)

Out of the five students (S6 to S10), only two students said that their classes have behavioral problems.

“Our class is very noisy.” (S9 and S10)

“Of course individual student doesn’t want to pass up their homework.” (S8)

“Sometimes there were students who did not respect teachers.” (S9)

“Some students always sleep during math lesson.” (S10)

“Although my friends very noisy, but it does not affected my learning.” (S10)

All the students will not bring the classroom problems to anybody else such as noisy. They will try to settle the noisy problem using their own ways such as ignore it, tell the friends not to make noise, keep quiet, none of their business, they will do their own work because it cannot affecting them. There are two senior secondary Year 3 students who are not interested in mathematics.
“Mainly because I cannot accept the subject. I always think that math is just something continually doing it without ending.” (S9 and S10)

4.7.4 (c) School C

All the five students from School C said that their mathematics teacher is very strict but he understands them very well. Likewise, students also understand their mathematics teacher very well. Their mathematics teacher used ‘small teacher approach’ to help those weak students.

“Interaction with us...our teacher is very strict” (S11)

“Sometimes, I know my teacher mood not good and sometimes mood is good.” (S12)

“I know that my teacher is in a good mood is while he is teaching, he is teasing us, then we know today teacher’s mood is good.” (S14)

“When teacher taught us formula, he looked very happy, we know he is in a good mood.” (S15)

“When we know that he is in a good mood, then we can have more interaction with him.” (S14)

“But he is very busy, we never disturb him.” (S12)

“My teacher understands us very well because he knows who are good and who are weak, he will arrange the weak students sit together with good student, to catch up with the topic.” (S13)
“Our classmates like to talk. But math teacher is very strict so we dare not to talk during his period. He will record if we talk. Overall we do not have discipline problem.” (S14)

“In our class, we have some classmates who have learning problems, teacher will match with the good one, and also keep on asking them about their understanding.”

4.7.4 (d) School E

All the students (S21 to S27) stated that they are very seldom not passed up their homework. Generally, students will try by themselves or ask their friends first before seeking for help from their teacher if they are facing problems.

“I will directly seek for help from my teacher, teacher will explain on the white board.” (S21, S26, and S27)

“I am a good student, I will think by myself first, if cannot only ask teacher.” (S25)

“I will ask my friend.” (S24)

“I ask my friends first, all of them do not know, then only I ask teacher.” (S23)

“Our class has 15 students, so teacher cannot have time for us. So I ask my friends, he sit in front of me, and he sit at the back of me, then I ask them lah.” (S22)

Their mathematics teacher has taught them for 3 years already. In such a long period, all of them felt that their teacher can understand them quite well. Students will have high self-esteem and interested in mathematics if they can understand.
“Because I know how to do. I see I can understand.” (S25)

“When I can solve the problem, I am very self-esteem.” (S26)

“I don’t like math because solving the math questions spent a lot of time. When I cannot solve, I have to ask teacher, think of the question.” (S22)

4.7.5 Summary of the findings of mathematics teachers’ PPK

Majority of the principals noticed that PPK is an important professional competence to mathematics teachers at the current situation but not many mathematics teachers possessed this PPK competency. Nevertheless, the rapport relationship between teachers and students somehow help to promote mathematics teachers’ PPK.

On the other hand, all the five senior assistants agreed that this PPK has a direct relationship with teacher personality. However, the close relationship between mathematics teachers and the advanced technological tool like Whatapp help the mathematics teachers to understand their students’ learning behavior, learning process and individual characteristics. Nevertheless, all the senior assistants agreed that this PPK competency is important in the current situation.

However, all the five mathematics department heads pointed out quite different views related to PPK. They mentioned that PPK is related to teachers’ teaching methods, the facilitating methods used in the class, and also the ‘follow-up system’. In addition, they found this PPK competency is important to help in mathematics teaching process.
Majority of mathematics teachers pointed out several important themes related to PPK. In order to motivate their students to study mathematics, they have to understand their learning behavior, learning process, and individual characteristics. All of them supported the ‘follow-up system’ so that they can understand their students in a better way. Mathematics teachers’ points of view are consistent with the points of views from their department heads. All of them found that this PPK competency is important to help in mathematics teaching process.

In conclusion, most of the senior secondary education students did not feel that their mathematics teachers have any PPK competency problems. They seemed to have very close relationship with their mathematics teachers.

4.8 Organizational Knowledge of Mathematic Teachers from the Perspectives of School Principals, Senior Assistants, Mathematics Department Heads, Mathematics Teachers, and Students

After a thematic analysis on the transcripts regarding organizational knowledge from the five principals, five senior assistants, five mathematics department heads, and 13 mathematics teachers, four themes about what constitutes to mathematics teachers’ organizational knowledge were identified. The themes of organizational knowledge are: (i) educational system and its institutional framework; (ii) management, governance, and transparency; (iii) the organization and ecology of the school including the legal form of school, the rights and responsibilities of students, parents, and teachers, and the role of school management, and (iv) school quality and effectiveness. Table 4.5 summarizes these
four themes and the composition of each participant’s views. However, the 27 senior secondary students’ transcripts were not analyzed according to the themes but looked into their views about the mathematics teachers’ organizational knowledge holistically.

Table 4.5 Participants’ view about what constitutes organizational knowledge of mathematics teachers

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<th>Themes of organizational knowledge</th>
<th>Gap between Dong Zong and CIHSs</th>
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Notes: P – Principal; SA – Senior assistant; DH – Mathematics department head; T – Mathematics teacher

Data generated from the interviews show that there are four themes from organizational knowledge of mathematics teachers in CIHSs. As indicated in Table 4.5
show that only the knowledge of management, governance, and transparency was found to be not much significant to mathematics teachers’ organizational knowledge.

4.8.1 The gap between Dong Zong and CIHSs

4.8.1 (a) Principals’ perspective

All the five principals did not feel that there is a gap between Dong Zong and CIHSs. Dong Zong made any changes, they would make sure the information and guidelines are given to CIHSs. The goal of Dong Zong is to maintain the high quality of UEC international standards. Majority of the principals made the necessary adjustment to reduce the gap if any. For example, some principals may advise those average students go to commerce or arts stream.

“To my opinion the gap between Dong Zong and CIHSs is quite narrow. For example, last year the change of exam format for math in science stream and commerce stream. Dong Zong has carried out the research together with head departments, senior teachers or work closely with experts internal or external of the country. They still remain their principle that is a very high quality level of math. Those students must have positive attitude and smart only able to take the applied math in UEC. Teachers also have to design very high quality questions for students to practice. If really consider my students who are able to take this subject are less than 10 persons each year. I am quite satisfied with my math teachers in their organizational knowledge to handle the change of exam format.” (P1)

“Generally there is not serious gap between Dong Zong and the school. School still can match with Dong Zong requirements. Recently for example, I heard some complain is about the change of science text book. Last time science subject are separated into 3 subjects namely Chemistry, Biology, and Physics but now they combined together to be in one book. So some Physics teachers for example cannot teach Biology and so on. For example I have one teacher who can continue her contract but do not want to continue because she said she cannot master all the three subjects together. This is the example that teachers who did not possess organizational knowledge” (P2)
The gap between the CIHSs education system set by Dong Zong is the UEC exam questions is too difficult. If the students can do well in UEC, they can go to any of the universities in the world. But if the students cannot pass the exam with good results they may not be able to gain the scholarship. For example, if they take A-level, which is not so much difficult will get a better result. A level exam, students just need to focus on four subjects while UEC needs to focus on eight subjects. They have to study three languages in CIHSs while A-level they do not need to study other language at all. Therefore our students are disadvantage in this kind of education system. Too difficult in exam make the UEC not realistic and lose the competitive advantage. Current situation, if Dong Zong still remain the high difficulty the UEC exam, may not be able to capture good students because they can easily go for A-level and get a straight A and enter outstanding universities. Weak students are not capable to take the exam because is too difficult particularly applied math and physic subjects. So we can just get the intermediate students. In addition, they have to focus on eight subjects, then they have no time to be trained in their soft skills for example public speaking, team work, good attitudes and so on. This is what I mean as the gap. Sometimes, I also cannot claim teachers as the practitioners.

The gap between the Dong Zong and school is unavoidable. But I always advise my students to go for minimum subject in SPM. Choose those specializations that easy to study. For example economic is not an easy subject, if the students cannot cope with it should go for art. I always want my students to be responsible to their decision made. Students need 6 credits to further their study in university. I always hope that the six years secondary education, my students will learn two things one is self-discipline and another is responsibility. I have explained to the students and return the responsibility back to students and parents to make their own decision. In this school, I found my teachers are doing the same as me.

4.8.1 (b) Senior assistants’ perspective

Majority of senior assistants have different views with their principals. All the senior assistants pointed out that the most of information, text book, syllabus, examination format given by Dong Zong are comprehensive. Therefore, mathematics
teachers in CIHSs must competent in their organizational knowledge such as they have to search for relevant syllabus, find their own references and so on.

“The information from Dong Zong to the schools is quite limited. For example, Dong Zong just provide the exam format, syllabus and text book. Information related to teaching methods, advanced contents are not provided. Fortunately, teachers can access to internet to access to the related information from China and Taiwan website because our syllabus and content of UEC are derived from China and Taiwan.” (SA1)

“The gap between Dong Zong and school, normally we will try to adapt to the requirement mentioned by Dong Zong. However if the information is not clear, teachers will call Dong Zong to get clarification especially in the exam format issue. For example, the calculator, so we need to clarify with them about what type of calculator is allowed to use. The reference for UEC is very limited so teachers have to create themselves the questions based on the past years questions.” (SA2)

“The vision of this school is to produce all rounded students rather than too much focus on academic. We have more 30 clubs, uniform units or games. Every student must involve in at least one of the extra curriculum.” (SA2)

“The gap between UEC and SPM is SPM allow students to use calculator while UEC not allow. In this case, I do not allow my students to use calculator. I do not have choice because once the students use calculator, they cannot handle UEC questions. To my opinion, objectives text paper 1 of UEC can let the students used calculator but subjective questions paper 2 do not need to use calculator because sometimes they press wrongly even worse. I have discussed with Dong Zong the person in charge because Junior UEC cannot use but Senior UEC can use. The objective questions for Junior UEC should let them use calculator because the questions are difficult, time is very limited to them. Good students face not enough time for them to complete although they know how to do it. For those weak students of course they have plenty of time.” (SA4)
4.8.1 (c) Mathematics department heads’ perspective

All the mathematics department heads found that there is gap between Dong Zong and CIHSs made the mathematics teachers need to have strong organizational knowledge like they have to modify by themselves the examination questions from other countries. This is because Dong Zong did not provide sufficient references, teacher guidelines, and relevant text books. Therefore, mathematics teachers in CIHSs must competent in their organizational knowledge such as they have to search for relevant syllabus, find their own references and so on.

“The gap between national school and CIHSs, I have taught CIHSs for more than 30 years. Last time UEC math was very much deeper compared to national exam add math. The past few years, Dong Zong keep on modifying the text book including the amendments made by last year. Currently, I found that the depth of the exam has been changed to be easier than before just because of to match the KBSM standard. So the uniqueness of the high standard has lost. So sometimes I like to use old text book which are more challenging. Even the exam questions also I found quite confusing.” (DH1)

“The strengths of UEC are on science and math at a very high standard. Although students cannot scored a good result, but their foundations are very strong, that is more important.” (DH1)

“Of course, Dong Zong set the UEC exam based on the overall standard and reach up to certain international level. For CIHSs in central and south, they will not have problem to fill up the gap. But for School B, only 20% of them can really do the Senior UEC exam questions. The questions in UEC exam and the questions in text book, is a big gap. The gap is in term of the format of the questions as well as the difficulty level.” (DH2)

“Yes, there is gap between Dong Zong and CIHSs. Dong Zong only provides us the senior secondary Year 1 the teacher teaching guidelines. However, there are no
teacher teaching guidelines provided to senior secondary Year 2 and Year 3. So we have to struggle on ourselves to search. Syllabus is too broad, it is time to review. It has been very long time did not review their curriculum. Dong Zong provide syllabus by attaching just the text book. But I hope to have teacher guidelines.” (DH3)

“Most of the time I would like to use questions from outside the schools. Because of our text book is in Mandarin, if I translate I worried that the meaning is not really matched. So I like to get from outside the school that have English version. As long as the topic is matched, it also saved my time.” (DH3)

“Yes, we have gaps of bureaucracy between Dong Zong and CIHSs. For example, setting exam and syllabus are different departments in Dong Zong. So sometimes the content not in the syllabus but come up in the exam, so teachers have to find the related content by ourselves. Sometimes what are in the text book not being examined. So sometimes we have known already, we do not teach that topic. We have very limited reference in Malaysia. We have to get the reference from Taiwan, China, Singapore. I even ask my cousin from Singapore to send related maths reference books to us, it costs more than thousands ringgit because we just got one text book from Dong Zong. Sometimes we also modify from STPM. STPM has 2 maths, one is pure math and the other is mechanic math. Pure math is the one we can have in UEC, mechanic math is not included in UEC. So we still have find ourselves.” (DH4)

4.8.1 (d) Mathematics teachers’ perspective

Majority of the mathematics teachers found that there was gap between Dong Zong and CIHSs made the mathematics teachers need to have strong organizational knowledge like they have to struggle to prepare their students to access to the high standards of UEC, train their students to solve the mathematics problem without using calculator, and teach their students with high speed to solve mathematics problems. This gap seems to be obvious to CIHSs in north because most of the CIHSs in south or central have achieved very high standards of student quality.
Regarding the gap between Dong Zong and CIHSs, from my observation, the standard of math is keeping increasing the difficulty level. It is hard to find their UEC exam questions are similar. The UEC exam questions have already reached a very high standard. However the passing marks has cut down, actually quite low. Sometimes, I thought my student cannot pass but end up he can pass. I have friend who is the marker admitted that the passing mark cut down to be a little bit low.” (T3)

“To my opinion, the gap between Dong Zong and CIHSs is because of central CIHSs are more excellent compared to the north CIHSs. Dong Zong aims to channel these excellent students to popular universities in Singapore, Taiwan so increase the difficulty in UEC. This will be very challenging to the CIHSs in north.” (T4)

“The UEC exam has a standard pattern. From what I know the UEC exam was set in such a way. From the teachers, Dong Zong sent emails to teachers if teachers are involved in setting UEC exam questions. Teacher has to send 4 questions and not necessary these questions will be appeared on the same year. In fact, I heard that Dong Zong will change some figure and they interchange between science stream and art stream exam questions. So actually it is quite flexible.” (T4)

“We feel that there is no gap between Dong Zong and their implementation. They can always give feedback to Dong Zong if there is any problem.” (T7, T8 and T9)

“The relationship between the Dong Zong and CIHSs is very close and is not a problem at all. Once Dong Zong has made any changing, they will inform us, give us training, and provide materials to us. So far Dong Zong has done it quite well. I also agree with Dong Zong not allowing students to use calculator. This will be better than using, students become more flexible.” (T10)

Personally, I am not agreed with Dong Zong not allowed students to use calculator in UEC exam which I feel that should let students use calculator. Like national schools they allow students to use calculator so that it will be faster, why Dong Zong not allowed CIHS students use calculator during UEC exam. The technology era has changed, UEC questions are very hard, yet they have to use their technique to solve the solution without using calculator.” (T12)
4.8.2 Knowledge of the organization and ecology of the school

4.8.2 (a) Principals’ perspective

Majority of principals found that their mathematics teachers know very well about their responsibility. They know very well about Chinese education philosophy. Their knowledge of the organization and ecology of the school is not questionable.

“Regarding responsibility, majority of my teachers know that they have to finish their syllabus, this is their responsibility and cannot postpone until next year. Training is important, teachers have to attend. Those teachers who are not attending the training seem to be don’t know the responsibility and they cannot manage it well especially their classroom management. So I will ask the head department for help. Assist the teacher let the teachers observe how she is teaching and so on. In CIHS, if you are not performing, you can be terminated not like national schools. Our teachers when become proctors, cannot read the handphone message, cannot do any other work, just look after the students. School has CCTV, if you do anything wrong, of course we will investigate, but if something happen, teachers have to take their responsibilities. Teachers have to explain to us why this can happen, this is their responsibility.” (P1)

“I have to always remind my teachers about their responsibilities and what should and should not do. Last time, I beat students, but I have already did not do that for 8, 9 years already. I advised my teachers not to beat students because some parents will unhappy and come to school to request for explanation. So parents do not want us to punish, we have to use other soft method. Behavioural problems are not so much so students who need the beat punishment also very less.” (P2)

“Generally, I let my teachers know about their responsibilities using various ways. For example, all the new teachers I will let them (i) know the history of School C which is going to celebrate its 100 years old birthday; (ii) We all study traditional moral teaching (弟子规); (iii) Let them see our success from some excellent teachers. In long run, when we keep on those problematic teachers, we will leave behind those good teachers. If most of the teachers are hardworking and responsible then those problematic teachers will be influenced. Teachers must know
that they are important because they are able to change their students' lives. In this school, very few teachers are lacking of organizational knowledge." (P3)

“From my experience as principal, the most difficult situation that I face is sometimes we can explain certain school regulation and cannot condemn teachers in front of students, this is something that I feel not comfortable. Therefore, I hope my teachers are more competent in organizational knowledge” (P4)

“New teachers will be informed verbally that they are not allowed to beat students. Teachers can only scold students. Of course some teachers still beat students and received complaint from parents that had happened before. He warned the teachers if this type of case occurred. Teacher guidelines and student guidelines had stated clearly all the teachers' responsibilities and students' rights as well.” (P5)

4.8.2 (b) Senior assistants’ perspective

Majority of senior assistants found that their mathematics teachers are excellent in their organizational knowledge that causing the popularity of CIHSs have been improved a lot recently. Chinese society started to lose confidence with public education coupled with several successful cases from CIHS students managed to enter into outstanding universities at global level has made a tremendous change in CIHSs. Most of the mathematics teachers know very well about their responsibilities.

“To my opinion, about 80 percent of teachers know about their responsibilities. We have general meetings, then followed small group meeting according to their subjects. Through meeting we make announcement and inform the teachers formally regarding their responsibilities.” (SA2)

“The development of CIHSs in Kuala Lumpur is very great. Their school size is extremely large they did not need to do promotion to ask for students. CIHSs become very famous partly because of teaching science and math in English. Most of the parents lost confidence on national school education system, uncertainty and
keep on changing and unstable are the most major problems that caused parents would like to send their students to CIHSs. Those students graduated from this school have managed to enter to outstanding top 10 world class universities like Cambridge University make the CIHSs in Kuala Lumpur more popular. Most of the CIHSs are moving forward to become international schools. Our competitors now are the international schools.” (SA5)

“Basic responsibilities such as working time from what time to what time, setting exam questions and submitted for checking and generally understood and followed by teachers. However, teaching and learning follows students’ progress still have differences between teachers, for example how serious when he set the exam questions, making teaching aids, some teachers are willing to sit beside the weak students to help them.” (SA5)

4.8.2 (c) Mathematics department heads’ perspective

All the mathematics department heads noticed that school has provided sufficient guidelines so that all the mathematics teachers know very well regarding their responsibilities. In fact, the teachers’ workload is quite heavy because they have to prepare for at least more than two types of public examinations. In addition, they have to do a lot of marking and all of these tasks required mathematics teachers to have high competent in organizational knowledge.

“Math teachers’ workload in School A is very heavy. Because of we have to give exercise to them every day. Today teacher has to mark their exercise book then only you can know what your students don’t understand. Then only you can cover up what they don’t know. We cannot delay our marking because once you delay you will delay everything. I can see my math teachers are very hardworking, everyday busy doing their marking. On top of that, we have to fulfill some school administrative duty and also prepare students for competition. They have to teach generally 26 to 30 periods per week. During their free period, they not only have to do marking, they have to settle many other school affair matter. Because of math teacher have 6 to 7 periods a day and also they are form teacher as well.” (DH1)
“School A has principal report which will be provided to all teachers a year before the academic year starts. In this principal report was stated clearly about the rules and regulations, as well as teachers’ responsibilities. So far, no problem was arisen about teachers regarding to their responsibilities. School A not allowed teachers to beat the students. Principal always advised teachers must consider about students’ psychology, do not scold students until you hurt their heart.” (DH1)

“All of them know their responsibilities very well because they are experienced teachers. Some of my colleagues are my former teachers.” (DH2)

“Related to right and responsibility, the teacher guidelines have informed us for example students who did not do homework have to stay back. We know about students’ development through New Era College about education specialization. The training is two years, every one of us have to attend during school holiday. Our time we went to Jit Sin School for all the CIHSs in north Malaysia, One week for short semester break and two weeks for long semester break, the total of six weeks per year we have to attend the training.” (DH5)

“Related to parents, normally they will not come to subject teachers, they will go for form teacher next only senior assistant for academic or discipline, or principal unless is related to that particular subject the parents want to know about the children situation, only go to see the subject teacher.” (DH5)

4.8.2 (d) Mathematics teachers’ perspective

All the mathematics teachers were informed by their CIHSs regarding their responsibilities through meetings and given guidelines.

“School will inform about the responsibility through meeting with senior assistant or memo.” (T5)

“New teacher should be able to understand their roles and responsibilities. I find our weekly meeting really can help teachers to solve problems and understand well their roles and responsibilities.” (T7)
“This school not allows teachers to beat students. Normally we will give warning, if still not work, we will send to disciplinary board, serious case will call parents.” (T7)

“We just have our open day last week, I am the form teacher, parents are ok, they discuss to us about their children. We did not beat their children will be ok. If the relationship between teacher and students are good, normally we do not have problems.” (T13)

4.8.3 Knowledge of the school quality and effectiveness

4.8.3 (a) Principals’ perspective

Majority of principals identified their school quality and effectiveness as 7 marks out of 10 marks. Basically, they all thought that there is still needed room for improvement. All the five CIHSs are improving their quality and effectiveness. The numbers of student enrolled into CIHSs are increased in terms of quantity and quality.

“If you asked me about school quality and effectiveness, I will put School A as 7 marks. There is still 3 marks for improvement from teachers and students. We get teachers from various resources, although turnover rate is not high but still have turnover. Therefore I feel that still need improvement. From students, you see we have two groups of students attending UEC and IGCSE, quantity and quality are both my concern. Uneven quality of students are very big in UEC group while IGCSE students for locals are quite equal but for international students especially from Thailand and Korea whereby they are not learning using English. So our teachers are very headache with them. In this case, it is very challenging to teachers about their quality teaching.” (P1)

“We have seminar which conducted internally related to provide students about their options for further study. I expect my teachers will be able to tell the students about the usefulness of math. Other than math teachers, the library head also provide us about further study or twinning program in China, XiaMeng or Taiwan.”
During the seminar, the library head also mentioned about requirement whereby students must have 5 credits to entry the university and one of them is math.” (P1)

“For me, I will evaluate my school quality and effectiveness as 7 marks. The parts that need improvement is academic. Academic performance needs a lot of efforts especially to change the students’ attitudes, cooperation between school and parents. The change of attitudes need a long time for our efforts. Like us to put so much effort but the parents also do not care so much. In this school regarding interpersonal relationship, interaction through extra-curricular in school no problem at all. Because of we always train our students.” (P2)

“If I want to determine School C at current situation, I will put it as 6.5 to 7.0. The 3 marks is because of teachers have to have various competencies, they are not only have to good in their teaching, their strategies teaching, being leader to lead 40 over students, counselling those students, discipline students’ attitudes, so forever cannot be perfect. Ok other than teachers, those teachers still need me to lead them, they still cannot work independently. Next the head department and teachers collaboration still need improvement. Therefore we sometimes have to change our organizational skills from time to time. Therefore it is still not perfect.” (P3)

“I will determine the school quality as 8 marks. Because we have limited of space, teachers treat students still can be improved. Student quality we cannot do anything but we still need to make sure that they have improvement from time to time.” (P4)

“I indicate School E quality level as 7 point because this school still has room for improvement.” (P5)

“These CIHSs now have a large number of high quality students which in turn bring up the excellence of the academic performance recently. However this situation did not happened in School E although this school also has brother national school.” (P5)
4.8.3 (b) Senior assistants’ perspective

Senior assistants gave their school quality at the level from 6 to 9 marks out of the total marks as 10. They found that several matters still need to improve such as professional training is needed to improve teaching quality, emphasizing on moral traditional teaching, and students’ foundation needs to improve or else students cannot cope with the high difficulty level.

“I give 6 marks out of 10 marks about school quality and effectiveness of School A. The part that we need to improve is teaching quality. This is because CIHS teachers are not go through professional training while they are recruited. They are only sent for training after they are confirmed to be recruited for a longer period. So new teachers have to adjust and adapt by themselves to teach their students.” (SA1)

“Every activity or program has to approve by the administrative board then only can be carried out. I gave 9 marks to school quality and effectiveness. The one mark is for space of improvement. This is because the world is keeping on changing, society demands are changing, so the one mark is for us to adapt to the change.” (SA2)

“Student quality in term of their behavior in School C, I put it as 8 to 9 marks. Of course, this school focuses on providing high quality of teaching, but we also emphasizing on moral traditional teaching．弟子规 in our daily lives. We are using 1080 words and 360 sentences in our daily lives practices to influence students’ behavior.” (SA3)

“I put School D quality and effectiveness as 6 to 7 marks. I have taught 10 years Junior Year 3 students. The major problem that I faced is students’ foundation is weak and I have to finish the syllabus because they have to go for public exam. Students have hard time for study if their foundation is weak.” (SA4)

“I give 7 to 8 marks to the two math teachers who can teach such weak students to such a level. This is something not easy.” (SA5)
4.8.3 (c) Mathematics department heads’ perspective

Generally, all the mathematics department heads gave 7 to 8 marks for their school quality partly due to several aspects still need improvement such as teacher quality, students’ achievement, teacher creativity, upgrading teachers’ skills, and providing relevant training to mathematics teachers.

“I give 7 marks to overall performance of School A. Firstly, teacher quality as I told you just now, still have room for improvement. I also hope that the coming head department in the future can develop math in School A in a better way.” (DH1)

“I give 7 to 8 marks to quality and effectiveness of School B. Basically the 2 to 3 marks is the students’ achievement. I hope that more students will get A or better result as well as the failure percentage of students will decrease.” (DH2)

“I give the overall quality of my math team as 8 marks. The less of 2 marks is creativity. I understand these 2 marks is not the teachers don’t want but because of they need to cover the syllabus, too heavy workload made the teachers cannot achieve these 2 marks. If the education can be more flexible, for example it is not necessary have to cover all the syllabus, teachers are free to design the lesson according the level of their students, fit their students interest, then the 2 marks will get.” (DH3)

“I give 7 marks to the overall quality. The 3 marks to top up is teacher quality in teaching method. Teacher must know how to teach and must go for training. Students are our important clients so teachers have to upgrade themselves to teach students in a better way. Even myself have been teaching for so many years still keep on finding methods to teach, not for helping me but helping my students.” (DH4)

“Specifically to student quality, I give 3 to 4 marks only. I only start from this year those students below 30% we did not offer to them unless they are from School E primary school. If quality for the teachers and administrators will be 7 to 8 marks. Only student quality is low. Most of teachers here faced with various problems of
their students until made them become very effective teachers. We learned about teaching must have set induction, giving assessment and so on from New Era College training that I mentioned before." (DH5)

4.8.3 (d) Mathematics teachers’ perspective

Only School C teachers gave a very high value to their school quality. They mentioned that School C has great improvement over the years. Besides, majority of the mathematics teachers gave seven marks due to several reasons such as student quality, meeting arrangements, and teacher quality.

“I give 7 marks because of student quality. Although this school has high entry point but we still face weak students.” (T5)

“I give 7 marks. This is because we have meetings sometimes after school. I feel that Saturday we have to come why don’t want to have meeting at that time.” (T6)

“I give 10 marks. I am qualified to say that because I am here for 20 years, I can see this school is keep on improving. From blackboard to now using LED, visualizer, the whole school have air conditioner. The facilities in this school are perfect. Now is the effort of students and teachers.” (T7)

“School C now has a lot of applicants, but every year, we can just take in about 300 students, not because of we do not want but because of no space already. If give us another block also not enough.” (T7)

“I give 10 marks to this school (School C) because of the facilities. For example, teachers last time have to teach with sweating but today the whole school is fully air conditioned. It is a great improvement in this school over the years. For those new teachers may not have this feeling like us.” (T8)
“I give 9 marks to School C because personally I feel no matter how good is the school progress, there is still have room for improvement.” (T9)

“I give 7 marks to School D. Just like me, currently I teach senior secondary UEC Year 3. I taught them since they were at Year 1. I am very satisfied when I see them improved. They do not have problem now everyday also passed up their homework.” (T10)

“I give 7 marks to School D. For me, I am teaching different class this year. I think is ok for me to know another new group of students.” (T11)

“I give 7 to 8 marks for teachers in School E. This is because most of our teachers are continue study in master degree like head department, he is further his master study in Zhang Hua University, Taiwan which is conducted in New Era College. But we will give 5 marks for students in this school.” (T12 and T13)

4.8.4 Knowledge of the management, governance, and transparency

4.8.4 (a) Senior assistants’ perspective

SA 1 gave a positive comment on mathematics teachers’ organizational knowledge regarding the management, governance, and transparency.

“To my opinion, school administration is quite transparent because all our assessment including the workbook checking, lesson record, students’ exam analysis are open to all teachers.” (SA1)

4.8.4 (b) Mathematics department heads’ perspective

Generally, all the mathematics department heads felt that they are having a transparent management system. They worked together with a high team spirit. They
always have discussion from time to time to improve themselves and use Whatapp group to interact among the group members.

“We have a quite transparent leadership. Yes, I put all my team members in whatapp group, any new information or training provided by Dong Zong, I will inform all of them not to the selective teachers only. For example, recently we have Xiamen University mathematics competition. All the math teachers must come although it is not a working day, to be fair to every teacher.” (DH2)

“We have discussion among math teachers is a common matter. Because math is a tough subject, we cannot solve all the problems, so most of the time we have to discuss among us. Although I am a head department but my experience is not as long as some of the math teachers in this school. If you ask me, if my team have problem come to approach me. I would like to say I approach them to discuss more than they approach me. Moreover, school purposely arranges all the math teachers sit together, that will easier for us to discuss.” (DH2)

“I am very transparent to my team. I always tell them that if you insist want to see certain steps that you taught them, then goes ahead with it.” (DH3)

4.8.4 (c) Mathematics teachers’ perspective

Majority of the mathematics teachers seemed to be reluctant to give any comments on their knowledge of management, governance, and transparency except mathematics teachers from School B. T4 felt that School B management is not transparent and teachers’ voice is not taken into consideration. School management is not following the new and advanced trend to manage.

“I give 6 marks to School B in terms of its quality and effectiveness. This year our school has a big change in administration. Once administrator change, the principles also change. For example the school administrator did not walk the talk. They want teachers to write lesson plan. But later I found that some teachers did not do, and no punishment has been carried out as they have said. So I was thinking
to myself, should I continue? Now the education is very advanced. Actually, we can download from the website, this is what I mean should be improved.” (T4)

“Another example is a lot of ideas is good but in the actual implementation, lack of monitoring. The school is not enough transparent. For example call for meeting, write an email to you one day before, write at the corner, look like trying to hide something.” (T4)

“Like want to have English UEC class, although teachers disagree, but still carry on. Our voice are not be listened.” (T4)

“Some teacher disagreed because some teachers never teach English before.” (T6)

4.8.5 Students’ perspective on organizational knowledge of their mathematics teachers

Owing to students may not know about their mathematics teachers’ organizational knowledge because they are not involved. Therefore, researcher probed their opinions towards (i) the overall quality and effectiveness of mathematics teachers’ instructions not only in the classroom and school and (ii) their responsibilities and awareness on school regulations.

4.8.5 (a) School A

All the five students in the focus group interview gave not very positive marks to their school quality and effectiveness, ranged from 6 to 7 marks out of a total of 10 marks. The reason is because they do not have enough classrooms so they have to share the classroom. If their teacher did not come, they felt just like the abandoned kids. Those students who gave 6 marks to School A, they have pointed out the matter relating
learning culture has to change. Students in this school did not like to study, they like more
in participating in extra curriculum. School A takes in every student, so the student
quality is not good.

4.8.5 (b) School B

When these five students were asked whether they know about the school
regulation or not, their answers are ‘Yes’. All of them know about it, they learn while they
first joined the school since Junior Secondary Year 1. All the five students in the focus
group interview gave quite low marks to their school quality and effectiveness, ranged
from 6 to 8 marks out of a total of 10 marks. Most of them felt that teacher quality and
their organizational knowledge competency need to improve. However, there are two out
of the five students are confidence to get A in UEC mathematics subject.

“Teacher quality is my major concern. Some teachers are good but if we are not
taught by the quality teacher. We have problematic teacher who is good but does
not know how to teach.” (S10)

“Math and biology, I can get A” (S9)

“Math and chemistry, I am sure that I will get A” (S10)

4.8.5 (c) School C

Among the five schools, students from School C seemed to be satisfied with their
mathematics teachers’ organizational knowledge. Students’ findings are in line with their
teachers’ findings. All the five students in the focus group interview gave 8 marks to the school quality and effectiveness except S11 who gave 9.5 marks.

“School has many activities, but personally I do not like too many activities although too many activities is very normal and common.” (S11)

“Extra curriculum - three times per week, Wednesday, Friday and Saturday, each time is one hour. On top of that, those involved in musical performance, use the time more than that. During holiday, have to come back to train and go for competition.” (S13)

“School provides sufficient facilities to us. But because of increasing number of students, school has limited of space, when we want to have activities, we found very difficult to share with so many students with a limited of space. May be this will be improved, because principal said he will expand our school land.” (S14)

“I am a christian and have many activities in church. In addition, school also has many extra-curriculum, I found difficult to find sufficient time for my study. And also I am very tired of activities. Actually this is not school problem, I myself not very like to study.” (S13)

“I feel that some school activities affected the teaching and learning process.” (S14)

“The total marks for extra-curriculum is included in our major exam and the marks are 6 marks, higher than the 3 science subjects. So every Saturday, I have other activity outside, so I have to leave early, and have to deduct my marks every time as 2 marks. To me, joining extra-curriculum is to make us enjoy but school is using marks to force us and determine us.” (S15)

“All the classrooms are fully air conditioning. So the facilities are good.” (S11)
4.8.5 (d) School D

Students from senior secondary Year 3 of School D gave a more positive evaluation to their mathematics teachers’ organizational knowledge.

“We give 9 marks because our teacher is a very good teacher. Our math teacher is a very patient to us, explain very clearly to us. Of course nobody can be perfect, so we give 9 marks. If we don’t understand, she will not condemn us and use different method to teach us until we understand.” (S18 and S19)

“I give 8.5, is averaged up the two math teachers. This is because everybody still has room for improvement including teacher and students, so the 1.5 marks is to give for the space to improve.” (S16)

“I also the same, we still need to improve.” (S18)

“We know about our responsibility because we can see what other people do and what other don’t do. For example, we cannot bring food into the classroom, I know about it because I have been punished for doing that.” (S18)

4.8.5 (e) School E

Students give quite a high score to their mathematics teacher’s competencies as 8 to 9 marks. There are five students gave 8 marks and the remaining students gave 8.5 and 9.0 marks respectively.

4.8.6 Summary of the findings of mathematics teachers’ organizational knowledge

Researcher summarizes all the five principals’ findings and concludes that mathematics teachers have sufficient organizational knowledge. They know very well
about their responsibilities and work effectively to narrow the gap with Dong Zong. Although all the CIHSs in Penang progress very well recently but there is still having room for improvements.

On the other hand, most of the senior assistants found that their mathematics teachers have to possess extra organizational knowledge. This is because they are not provided sufficient reference, guidelines, and also the contents in the textbook not exactly the same as the coverage of UEC. Therefore, majority of the senior assistants pointed out that it will be very challenging to the mathematics teachers if they are lacking of organizational knowledge.

Findings from either the five mathematics department heads or the 13 teachers showed that they have the similar opinions with senior assistants related to organizational knowledge of mathematics teachers. They highlighted mathematics teachers in CIHSs not only not provided with sufficient reference, guidelines, relevant textbook but also they have to develop themselves the examination questions based on the syllabus and referring to other external public examination from Taiwan, Singapore, and China. They felt that mathematics teachers need to have extra-ordinary organizational knowledge.

In conclusion, most of students aware about their responsibilities and know how to behave themselves. However, most of them gave seven marks to the overall quality of the school because of the school management issues. Only School B, students felt that their mathematics teachers are good but not quality. In short, mathematics teachers are found to be lacking of organizational knowledge in School B particularly.
4.9 Counseling Knowledge of Mathematic Teachers from the Perspectives of School Principals, Senior Assistants, Mathematics Department Heads, Mathematics Teachers, and Students

After a thematic analysis on the transcripts regarding counseling knowledge from the five principals, five senior assistants, five mathematics department heads, and 13 mathematics teachers, four themes about what constitutes to mathematics teachers’ counseling knowledge were identified. The themes of counseling knowledge are: (i) competency in dealing with students’ educational career; (ii) competency in dealing with students’ learning difficulties; (iii) competency in dealing with students’ behavioral problems, and (iv) consulting competency. Table 4.6 summarizes these four themes and the composition of each participant’s views. However, the 27 senior secondary students’ transcripts were not analyzed according to the themes but looked into their views about the mathematics teachers’ counseling knowledge holistically.

Table 4.6 shows that all the participants considered mathematics teachers should be able to deal with students’ educational career more than other components of counseling knowledge. Findings showed competency in dealing with students’ behavioral problems and consulting competencies should be under the responsibilities of school counselor not mathematics teachers. Besides, most of the mathematics teachers in CIHSs are not facing the problems of students’ learning difficulties causing them do not need this component in their counseling knowledge.
Table 4.6 Participants’ view about what constitutes counseling knowledge of mathematics teachers

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<th>Themes of counseling knowledge</th>
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4.9.1 Competency in dealing with students’ educational career

4.9.1 (a) Principals’ perspective

All the principals did not recognize this competency in dealing with students’ educational career is needed by a mathematics teacher. To their opinions, mathematics teachers have already had very heavy workloads in teaching so the counseling knowledge
dealing with students’ educational career should leave it to the counselor. Besides school has prepared sufficient number of counselors with the major responsibility is to provide all the educational career information to students.

“In School B, students will get their academic study information through counseling department. I identify the proportional as one counselor: 500 students. This is following the quota required by Ministry of Education. Currently I have four professional counselors and one assistant. By next year, my student will reach 2400 then I have to employ one more counselor who is graduated from Taiwan. Currently I have only the counselor graduated from local universities. My counseling session is put in the classroom time table, as one period per week same as music class. So, in general math teachers will only highlight the relationships of math to the future career will be sufficient. Other details information about counseling should leave it to the counselor.” (P2)

“Nowadays, students are not matured, can question why they should learn math. They also do not know what they want to be. Therefore I always have seminar regarding further study in universities and also talent assessment to identify their strengths and give them proper counseling. I have one counseling head, one assistant counselor, one teacher counselor, and one outside advisor. I have more than 1700 students, current counselors that I have still not enough if we count by ratio of students. Because we need psychological counselor, further study counselor, I mean the professional counselor is not enough. I do not want my math teachers to do counseling work. For me, as long as they utilize students’ learning time in class is good enough counseling job leaves it to our counselor” (P3)

“Therefore the counselor’s main role is providing students with information about their tertiary education and career guidance. He always let the students know about the main aim of this school that the high school education is at the middle level whereby students should continue their study and not encourage to stop half way.” (P5)
4.9.1 (b) Senior assistants’ perspective

Senior assistants have different views related to this matter. They pointed out that mathematics teachers need to inform students about the importance of learning mathematics and relating mathematics subject to their future educational career or daily lives. Senior assistants found that mathematics teachers need to possess this element of counseling knowledge in order to motivate them.

“No matter what, I feel that learning math can increase students’ carefulness. For example, 2-3=-5 but students can give answer as +5, -2+3, so that with bracket and without bracket different. So students can train to be more careful.” (SA4)

“We have problem of students who are not interested in math at all. For example some students like housekeeping subject. So I always tell them if you make bread, you also need to use math to weigh the flour. If you want to have bakery house, you have to do your financial management in your business also related to math. So students need to be channelled to focus on math will sometimes enable to create their interest. Their interest in math is our major problem.” (SA4)

“Parents here are not encouraging their children to further study, keep on asking their children to work after graduating. This will demotivate the students to work hard because they know that they will stop from learning after the high school education. Actually the opportunities for our students to further study is very great, many universities in Taiwan provide not only ample of the study vacancies but also the scholarships and UEC exam not really very difficult, still can reach the performance if our students want to work hard.” (SA5)
“Our school has to have parent counseling most of the time. School E provides activities to occupy students with healthy physical exercise for example playing basketball rather than playing computer games. But parents cannot understand, they think that their students wasting their time to play not to study.” (SA5)

“All the further study information, students will get from counselor, unless some students would like to approach the related teachers if they would like to proceed in that area. Our students are very small, like Senior Year 3 class just has 30 plus students, so if there are any offer packages from any university, the counselor can easily inform the related students.” (SA5)

4.9.1 (c)  Mathematics department heads’ perspective

Majority of the mathematics department heads pointed out that mathematics teachers should have this competency so that students will be motivated to study hard. Besides, those students’ ambitions are related to mathematics subject will have better focus on their study. Students will have clear personal goal if mathematics teacher possesses this competency.

“School has a counselor as further study guidance head helps to inform about the students’ further study information. Students who need this kind of information will go to see him because he has a lot of information. From time to time, he has seminar to our students About 80% and above of our students in examination class, they are clear about the information for further study.” (DH1)

“I advise them to work hard on math because in university they want 5 subjects have credit. If they do well in these two maths namely applied math and general math, they have already 2 credit out of 5, so is worthy to work hard.” (DH2)

“My students sometimes they can relate math with career. These few years, our school has done some construction, so I showed to the students about the career of quantity surveyor job, that they do calculation before start building a building.” (DH2)
“Students always ask me why they have to learn math. I will tell them math can polish their thinking. For example calculus, because we do not know how far the students can go, what career he will involve, so we have to learn all. Unless they become engineer then only they will use calculus.” (DH3)

“I seldom tell them that their future career will relate to math. I never say that because I know it may not relate to their career. Students know whether math is useful or not but they just want the teacher to say out only. Math is not like language, language definitely they will use it because once you want to fill in the form, you have to use the language that you learned.” (DH3)

“Yes, my students ask me why we have to learn math. My answer to them is from the basic things that we do, for example you go shopping because we are girls, we like shopping. So I ask her if the departmental store gives discount 25%, how much you have to pay, this is math, you are doing math in your daily life. I also give example about what time you wake up, 5 o’clock in the morning, where is this come from? Also math, so learn math can get many advantages. I also give example about MH370, people are counting this airplane dropped in where, we also use math to count. My students said we do not need to use until so deep. I told them how I know that today I become math teacher while I was studying in economic. Just the wall paper that you need to fit also need math to calculate. Our students we need to explain to them in a simple way.” (DH4)

“My students cannot understand what are the careers related to math. We have to find related information for our students to further study. For example, last year, I have one student who are good in math, scored 2 A for the 2 maths subjects but other science subjects are not good. I encouraged her to do math. At first she wants to go for nursing, I told her she should try study math. Now she studied math but she is so worried that she cannot cope. I insist her to try first.” (DH4)

“Normally our students only face the procedure problems. Generally for those want to further study know what they want and also for those want to go for working also know what they want. In this school, we have one counselor, so about the procedure, students will refer to them. In our school further study ones will be less than those want to go for work with ratio 3:7. Last time the situation even worse about 2:8 or
1.9. The 70% of students or most of them will sell handphone, insurance agent after their high school education. *(DH5)*

4.9.1 (d) Mathematics teachers’ perspective

Mathematics teachers told that they have to remind students from time to time regarding the importance of learning mathematics. Smart students have their career goal but weak students are always questioning about the rationale of learning mathematics. They pointed out that mathematics teachers need to inform students about the importance of learning mathematics and relating mathematics subject to their future educational career or daily lives. Mathematics teachers felt that they have sufficient counselling knowledge to motivate their students.

“I have one student who intended to study hotel management so he told me he does not need math. He just copied notes and did the minimum requirement as I requested. He got Grade B in UEC exam is considered as good result. He got an offer and the university asked him to go for math test before intake him as a requirement. Ha... Ha... he thought he does not need math at the beginning. He went to tell his juniors about math is needed in hotel management because they have to check stock, marketing, sales all are related to math. Actually, all the university specialization needs math as minimum requirement.” *(T2)*

“Weak students will question teacher why they have to learn math. Of course, good students may go for engineer, architect but weak students may not think of that. I answer to them if you make roof, you also need math because not all the roofs are rectangular, we can different shape of roof. So this will improve their confidence to study math because math not only for high position job but also needs for blue collar job.” *(T3)*

“Quality of the students is the major problem. Students are reactive not like us last time we are more proactive. I have the same problem as T6. Students always ask why they need to learn math, what is the purpose of learning math. If they cannot find the answers, they will not have the interest to learn. I will give them the answer
as math is helping them to solve their other daily life problems. Such as they go to market to buy something, you need math." (T5)

“At the first day of the class, I have already told my student the importance of math and English in university.” (T6)

“When students ask me about the usefulness of math, I said once you work you will know. Of course not all the career will use what they learn.” (T7)

“If students need career counseling, we will send them to counselor. This school does not have serious behavioural problems, I mean still under control.” (T7)

“I told my students by learning math enable them to be self-improvement. Junior students may not know the importance of math with their future study in university. But senior secondary students will know that most of the program will need math as minimum requirement. I can see my students study hard in math because they know that this is the minimum requirement for them to further study.” (T8)

“To my opinion, the learning process of math is important not the results. This is because math can develop many types of people skills such as observance, analysing skills which I found they are more important. In School C, senior secondary UEC class have 7 classes, out of the seven sometimes we have one and a half to 2 classes of pure science.” (T9)

“Yes, students sometimes ask me why they have to learn math. I tell them that learning math can make them have logical thinking. Sometimes we use math in our daily life without noticing it. I tell the students that they do not know what are the future career, so you learn more, there is the possibility that you may use it one day.” (T10)

“Students sometimes ask me why they have to learn math. I tell my students that learn math will help them in tertiary education even though it may be not their major option but most of the university programs have indirect relationship with math. Other than that, math makes them shrewd in doing work.” (T11)
“Along the teaching, I always tell my students about the importance of math and their future career.” (T13)

4.9.2 Competency in dealing with students’ learning difficulties

4.9.2 (a) Principals’ perspective

Majority of principals pointed out the major factor of students’ learning difficulties is due to their family background whereby they have been neglected. Most of them are coming from either broken families or busy parents. To principals’ opinions, there is not much that the mathematics teachers or school administrators at high school level can help. Another factor is those students have also been neglected by their elementary teachers that caused them could not cope at all at high school education because their foundation was too weak.

“If academic problems, math teachers normally will refer to head department, some also refer to me or senior assistant.” (P1)

“Generally School E has two types of students. The first type of students who have already gained their love from the parents and come to school to seek for knowledge and the second type of students who are lacking of love will seek for love in school. School E has many students from the second type who came from broken family and looked down by their elementary school teachers. The failure from elementary school teachers are something that undeniable. For example, there are still a number of students who fail to read, speak and write after six years of elementary school education. These students will tell you that their elementary school teachers had gave up and labelled them as useless person. The philosophy of this school is religious based therefore this school has to play the role to guide the students to the right path. The most important in the whole education system should be at elementary school education. Students at elementary education felt that they did not gain enough care from teachers. In addition some of them hated their teachers.” (P5)
4.9.2 (b) Senior assistants’ perspective

Senior assistants’ opinions are consistent with principal’s views. The CIHSs have their own management system to handle students’ learning difficulties. However, SA3 and SA5 highlighted that students have learning difficulties in mathematics subject because they could not understand the contents as well as their foundation is too weak. Most of the mathematics teachers used retaining method to solve students’ learning difficulties.

“If students have problems, firstly the subject teacher will try to solve it. If cannot, will refer to form teacher. If form teacher still cannot solve it, will refer to discipline board and some may refer to administrators.” (SA2)

“I have received two complaints from parents recently. The first case is the parents complained that their child cannot study in the class, cannot understand what the teacher taught. The teacher is a new teacher. I have to give her the chance to grow. So I went to observe her teaching, she is an applied math teacher, I am not an expert in applied math. If I can understand her lesson, this shows that students should be able to understand too. Likewise if I cannot understand, the same will happen to the students. After her teaching, I have a short discussion with the students to come up with the appropriate method. After that, I informed her about the suggested method and asked her to try out.” (SA2)

“The second case is the parents complained that the child did not do homework. This is something not normal because usually teachers are the one who complained students did not do homework not parents. So I found out from the student He said that he cannot see because he is sitting at the back. He has short-sighted and did not wear spectacles. After I found out the source, I asked the students to finish all the homework before going back home.” (SA2)

“Learning problems such as did not do homework will be the most cases send to me compared to other problems. Among this, language subject on this matter will be more comparatively because it needs writing skills. Science and math although less,
but mostly because they cannot understand and don’t know how to do it. Normally, for those students who have family problems, we do not get involved but we just advise and explain to them, let them think by themselves before they decide to take any actions.” (SA3)

“Students in this school are different from my previous schools. My previous school students’ parents mostly are highly educated who can teach and guide their children but not in School E. These students are weak because they do not do self-regulate learning. So when they reach Senior UEC level, they are lacking in expressing skills in writing. The foundation of students is our main concern. Because math cannot read, must practice a lot in their past year questions. Besides, the writing speed is also very important.” (SA5)

“Those students have learning problems, math teachers will settle by themselves. Students with family problems will deal with parents through counselor and administrators. Learning problems for Senior Year 3 or Junior Year 3, we have preparation class after schools. For those not exam classes, we have extra guidance class for weak students. Because of the class size is small most of the remedy or enrichment activities can easily conducted during class hours. The most important matter is teacher must know how to plan for them. This kind of arrangement not to say perfect but has its effectiveness. Our applied math Senior UEC teacher can use the class remedy activities to improve our weak students up to 60 percent achievement.” (SA5)

4.9.2 (c) Mathematics department heads’ perspective

Mathematics department heads’ opinions are consistent with principal’s and senior assistants’ views. The CIHSs have their own management system to handle students’ learning difficulties. However, they also highlighted the same points that have been highlighted by senior assistants such as students have learning difficulties in mathematics subject because they could not understand the contents as well as their foundation is too weak. Most of the mathematics teachers used retaining method to solve students’ learning difficulties.
“For students who have learning problem, firstly the math teacher will try to solve it. If cannot will send to me as head department. If still cannot, will send them to counselor or administration.” (DH1)

“My class does not have discipline problem but they have learning problem. This group of students sometimes have attitude problem. Because they are quite arrogant thought they have already understood, once teachers scold that, they will not happy and show their long face.” (DH3)

“As you mentioned just now UEC math is very difficult. The major problem is mainly from primary school. The foundation is not good, so students start to join in junior secondary Year 1, they have to struggle and cannot cope with it. The gap is very wide between primary and junior secondary. Just as positive negative questions in Year 1, students really blur about it. Almost 70% of students cannot cope with it.” (DH4)

4.9.2 (d) Mathematics teachers’ perspective

At this point, finding showed that mathematics teachers look into students’ learning difficulties differently if comparing to their direct leaders. Mathematics teachers mentioned about the students’ learning difficulties in mathematics subject because of this subject is very abstract. For those students who cannot think abstractly may face the difficulty to understand the whole subject.

“Math is something very abstract, so students may not be developed their interest. Math do not have picture, just the figure, so students do not like.” (T6)

“My class have hyperactive students. I normally try to help them. For example, if they like sport let them run around the field, I feel that if you punish them also not working.” (T12)
4.9.3 Competency in dealing with students’ behavioural problems

4.9.3 (a) Principals’ perspective

In general, all the CIHSs have their own system to control students’ behavioral problems such as ‘reduction mark system’, ‘repeating the study’, and ‘disciplinary record’. Most of the students in senior secondary education do not have behavioral problems. On top of that, all the five CIHSs have their established procedure to handle students’ behavioral problems. Starting from subject teacher, form teacher, discipline board, counselor, senior assistant to principal.

“But if students’ behavioural problem, math teachers will refer to form teachers most of the time. Form teacher plays very important roles and have influenced toward students up to certain level. Because of every morning, form teachers have to enter their class for morning reading. Other than that, they have to follow the same class for three years unless she has not working here. Other than form teachers, they will refer to discipline department. Unless the behavioural problems are very serious, teachers will refer to me. For example, recently we suspect one student about H1N1 then teacher will refer to me or the students have oversea parents, they will send to me. However, most of our math teachers are also form teachers, majority of them still have sufficient competency in dealing with students’ behavioral problems” (P1)

“Generally, problematic students will send to disciplinary board first. Only those serious case then only send to me. Because all the students have gone through a traditional moral teaching in CIHSs, so discipline problem not many. When students sent by teachers to me, they normally will admit their mistakes. They know that if I beat them will be very serious because their flesh can come out as well. I was a discipline teacher before, at that time, I have to control three parties of naughty students that I have to control. Serious cases I don’t expect my teachers have the competencies to settle” (P3)
“The most common method that my teachers used to solve weak students’ discipline problems is punishment. In this school, we are using reduction mark system. If they did not do their homework, subject teacher will re-deduct their marks in their behavioural booklet until five marks then send to form teachers, form teachers can deduct their marks until 10 marks. If the students still refuse to change their behavior, we will call up parents through form teacher to school. After the discussion with parents still does not solve the problems, student will send to disciplinary board. Discipline teacher will punish them to sit at the corner to do their homework if the discipline problems are related to not doing their math homework” (P2)

“Parents who have problems in this school are those who do not care about their children’s academic achievement. When I asked these problematic parents to come for discussion, they felt this is irritating. In order to successfully guide the students have to come from three perspectives namely students themselves, teachers and parents who are ready to help them. Although teachers’ competencies is something important that cannot be denied, parents and students also have to play their roles as well. If not, even though we have put on a lot of efforts still fail to have any impacts on the students. Some students whom have been trained in school to correct their attitudes but turned to be ineffective because they have faced the bad situation at home particularly those broken family.”

“In order to solve the students' problems, parents counseling is the key factor. Sometimes I scolded the parents if their attitudes are unacceptable. However I will stop from scolding once I realized that the parents started to calm down. This is followed by counseling the parents. In term of students’ discipline behavior, not much that our teachers can do in School E” (P5)

“If my teachers face some students’ behavioural problems, they seldom come to see me, most of them very capable can solve by themselves. Normally, most of the school problems, I like to make it informal, will settle over the tea break, or meal in the canteen.” (P2)

I give the importance to behaviour. In this school, if your discipline get Grade C then they have to repeat your study. (P3)
4.9.3 (b) Senior assistants’ perspective

Majority of the senior assistants pointed out that only those students’ behavioral problems that related to mathematics subject need mathematics teachers to solve them. Otherwise, mathematics teachers do not need to take any responsibilities. Most of mathematics teachers were found to be capable to dealing with students’ behavioral problems such as they did not do their homework and sleeping while teacher was teaching. Most of the students’ behavioral problems are not serious at all the five CIHSs.

“Students in this school do not have much discipline problems but they do not have direction to study. They don’t know why they should study. Students do not have motivation to study. Nowadays, research findings showed that if people keep on watching something moving such as playing handphone games, they cannot study something not moving like book. This is a challenge in education.” (SA2)

“Common problems that I met are students did not do homework and did not bring their text book. Normally, discipline problems that affecting the teaching and learning process in the classroom is almost nil. If students did not do their homework, I will find out the source of the problems. Is it because of they do not understand then cannot do? I always give them warning but no punishment. This requires them to make appointment with their math teachers to seek out for help. I will communicate with teachers to find out the students' learning situation.” (SA3)

“If I found out that the students are lazy, do not pay attention, I will not allowed them to go back home before they finished their homework. I will call the parents to let them know and arrange transport for their children, let the parents signed up the agreement letter. Once we do that, very low percentage of the students will repeat the same problem. I always let the students learn that they cannot escape for not doing homework.” (SA3)

“Students who have problems not pass up their homework, to my opinion depends on whether experienced or new teacher. Normally, students are very smart. For experienced teachers like me normally students afraid of not passing up their
homework because they know that I will call their parents and said that your children will go home late because did not do homework." (SA4)

“The discipline problems, we have three categories. The first category for example related to study, did not do homework, absent from the class, math teacher will have to solve it. The next category can be divided into two that is criminal case for example stealing, fighting, go against school regulations, which we can make police report, considered as serious case. The third category is non-criminal case, for example did not come to school. This kind of discipline problems are not in math teachers’ responsible boundary so we as administrator, counselor will handle them and can cause the students to be terminated from the school which we seldom do it. We will see the parents first. Normally we want students to learn how to responsible to their bad actions. We may want him to do some services as punishment. Sometimes if the student really shows that he does not like to be part of the school, purposely create problems, we have to terminate him. However students act against the teachers, we have to investigate both sides, teachers sometimes need to be emotional controlled as well.” (SA5)

4.9.3 (c) Mathematics department heads’ perspective

Majority of the mathematics department heads mentioned that they only deal with those students’ behavioral problems that related to mathematics subject. Otherwise, mathematics teachers do not need to take any responsibilities. Most of mathematics teachers were found to be capable to dealing with students’ behavioral problems such as they did not do their homework and sleeping while teacher was teaching. Most of the students’ behavioral problems are not serious at all the five CIHSs.

“If students have behavior problem, math teacher will solve by themselves first. If cannot will send to disciplinary board.” (DH1)

“Discipline or behavior problem, may be because of I am a discipline teacher before, students are afraid of me. Now I am no longer discipline teacher. I just face students’ learning problem I never face students’ behavior problem.” (DH2)
“Math teacher will send students with discipline problems to discipline teachers. They seldom refer to me related to students’ behavioral problems. Even though I am a head department but I have the same workload as other teachers as 28 periods per week. So even students have behavioral problems, math teacher also did not refer to me.” (DH2)

“I teach science class, students are ok, good behaviour. But for weak class is different. For example one student complained by the math teacher does not have calculator so I called her father to buy for her. After the father bought for her, she brought to me saying that she does not know how to press. Another example, teacher asks the student to draw graph, student draw a cat and put two eyes, and saying that don’t you think that is beautiful. They are lack of readiness to learn.” (DH4)

“Most of students are naughty and also weak in some of the classes. It depends on if students not bring their textbook, teachers will send to senior assistant. What the senior assistant do is ask those students who did not bring text book to face the Buddha image for a period in our hall.” (DH5)

4.9.3 (d) Mathematics teachers’ perspective

Mathematics teachers’ capacities in dealing with students’ behavioral problems were depending on the teachers’ personality. For those strict mathematics teachers they did not have problems to deal with students’ behavioral problems. However, school still has the management system to help mathematics teachers who are lacking of this competency.

“I have one case whereby the student said he discussed with other teacher so that he did not attend my class. I said ok, let the teacher write a letter to me showing that you are together with her. But I found that the letter was written by himself. When I asked that teacher, that teacher said she asked him to go back to class to study. So I sent him to senior assistant. Because he is foreign student, I have to send him to senior assistant so that she can meet with his parents to discuss the matter.
This student not only did like this to me but also did the same to other teachers.” (T2)

“So far I do not meet with students’ with learning disabilities. But I face students’ attitude problems. So normally I will settle by myself, give more attention, make them more proactive. If discipline problem for example skip class, not coming to school, is solved by form teacher not us. But students do not bring text book, sleep in class have to be solved by subject teacher. So far this is seldom happened to me because I am teaching in pure science class.” (T3)

“Our school discipline board is quite effective, very strict and students are quite afraid of the discipline teachers.” (T4)

“I am very strict, I can scold students. Most of my students are scared of me. I will ask my students to buy a new textbook if they did not bring.” (T13)

4.9.4 Consulting competency

4.9.4 (a) Principals’ perspective

In general, most of the principals did not consider consulting service as part of mathematics teacher’s job specification. Moreover, counselors have carried out all the necessary consulting service. However, most of the students refused to see counselor to get consultation even though they have problems.

“Counseling department not only provide further study information, but also provide behavioural development. For example, if they receive any misbehaviour report from disciplinary section, they will work it up. We are very concern about overall development of the students. We have a very conducive counseling room, two small rooms for individual counseling and one big room for group counseling. Last time, we have male counselor then when he gave counseling to female students, he had to open door. Now he has gone for further study, we left only female counselor. Actual our counseling service is doing quite well.” (P2)
“Most of the students refused to see counselor due to they felt losing face. Their friends will tease him if they know this student had met with counselor. Most of the students who had to see counselor had both learning and behaviour problems. Teachers would like to send their problematic students to principal than to counselor because of I always asked them to send their students to me if teachers failed to handle them. Counselor in this school has to teach and become form teacher as well.” (P5)

4.9.4 (b) Senior assistants’ perspective

Majority of the senior assistants pointed out mathematics teachers should have consulting competency in order to manage the class. Mathematics teachers who have problems seldom consulted to senior assistant but their department head. Mathematics teachers like to manage their class through peer-mentoring system.

“10 out of the 16 math teachers in School A have the counselling competencies I still want to emphasize this point that if the teacher cannot manage the class, is very hard for her to have quality teaching. I always advise the new teachers that they have to set up their role model image for the first three months in order to proceed with this teaching career.” (SA1)

“Most of the teachers will refer to their head department when they are facing teaching problems or students’ learning problems.” (SA2)

“Normally, critical problem from students are those facing family problems, such as parents divorced, or family relationship not harmony. Students react differently to attract attentions or hopefully can recover the parents’ relationship. So teachers will find out the source first, discussed with parents. Discipline board and counseling have to work closely. Our roles here are just to promote the understanding of students on rules and regulations that they should follow in order to get protected. Counseling play the roles of directed the students’ negative behavior to positive. The numbers of student in this school have this kind of problem not many, not more than five cases.” (SA3)
“I observed our math teachers understand our problematic students through their peers. Then we communicate with him transparently. Most of the parents have communication break down with the children caused the misunderstanding between them.” (SA3)

When teachers communicate with parents, they will put themselves as friends to them. I will discuss based on my experience together with teachers because I also somebody’s father, then the parents seem not to be defensive. After discussing with parents, then only we ask the student to come over. Of course before that we have communicated with the student already. Then three parties, teacher and I, student, and parents will solve the problems together and I always highlighting about tolerance when we have discussion.” (SA3)

“I always have to let parents understand that students at the age from 13 to 18 years old, they face a lot changes including psychological and physical changes, peer influences and so on.” (SA3)

“These two math teachers (DH5 and T12) are no problems in handling students. Most of the students are afraid of them. They don’t have the problems like students did not bring text book, sleep in the class, did not pass up homework and so on. We have some teachers everything also passes to us but we have to give them support especially to new teachers. We always provide them space for development, we also understand that these teachers are quite young and lack of experience and do not have education background, so we have to help them to grow to deal with our weak students. Some young teachers nowadays very calculative, they said that wasting their times, teach so many times still cannot understand I will always advise them not to be like that as a teacher. Being a teacher, we just need to contribute to the teaching and learning process but we cannot expect that one unit of contribution can get one unit of output, that is not a necessity. Teaching is something that cannot be accounted with figure. If you cannot accept this, then you should go for business not teaching.” (SA5)
4.9.4 (c) Mathematics department heads’ perspective

Majority of the mathematics department heads pointed out mathematics teachers should have consulting competency in order to manage the class. They know how to relate their teaching with students’ daily lives and also they know how to share experiences with their students.

“Students are always questioning me why we have to learn math. I always like to relate math with our daily life. I ask my student what time they wake up, they said 6 o’clock, I told them that is math. I said the day you wake up until you go to sleep, all these are math. For example when I explain to my student +56, I relate to example like you have RM5 and your friend borrow from you RM6. I also tell them a lot of the things that they learned in math, they may not use it. But math is a thinking subject and they have various solutions to solve it. Therefore, when they go to work later, they may face a lot major or minor problem, they will able to think and solve the problems I tell students, if I am not a teacher, all the formulas that I memorize during my schooling are not used at all. But by doing math, it help us in our attitude and idea to solve problems.” (DH2)

“Normally I like to use my way of learning maths to my students and I share with my students that many courses or program are related to maths when they further their study. Students always think that if they further their study in sports or language will not relate to math, I always tell them not, you still have to overcome math problems.” (DH5)

4.9.4 (d) Mathematics teachers’ perspective

Mathematic teachers liked to use their personal experiences or daily lives to consult their students. Majority of the mathematics teachers felt that they should have consulting competency in order to manage the class. They know how to relate their teaching with students’ daily lives and also they know how to share experiences with their students.
“Just like students playing square box, I told them this is basic concept of math. We always use calculator all the time. So I found that although I am a university graduate but I cannot defeat the aunty who sells vegetable at the market. So later I do not want to use calculator. As I said only number 0 to 9 is enough for students to survive. Just like my students who want to become insurance agent, I told him just learned 0-9 is enough. I would like them to know the important of number.” (T3)

4.9.5 Students’ perspective on counseling knowledge of their mathematics teachers

The counseling knowledge from the 27 students’ transcripts were examined based on mathematics teachers’ competencies on how to relate mathematics to their students’ educational career, dealing with students who have learning difficulties, behavioral problems, and their consulting competency.

4.9.5 (a) School A

In regard to students’ behavioural problems, first of all students will refer to senior assistant, then followed by counselor. However, all of them do not have these kinds of problem because they are at Senior Secondary Year 3 and matured enough to behave themselves. Therefore all the students who involved as the participants do not have this kind of problem.

“Actually learn math is important to science stream students. Also for us commerce students, math is important for us to further study.” (S1)

“Most of the time, math becomes important for science students’ in their career.” (S2 and S4)

“...because even we learn physic, chemistry, we still use math.” (S3)
“...even accountant in commerce also need to have math.” (S1)

The five students have different ambitions such as air craft engineering, related to chemistry, biology and chemistry. They also felt stressed in their studying.

“I feel very down this year because I am good at language but I have to study for 9 subjects in senior UEC exam. But I believe once I can overcome it, it should be ok.” (S1)

“I feel very stress, 24 hours is not enough for me to prepare for the UEC.” (S2)

“Almost every month, we have further study seminar for us, so we know the requirement in universities like Australia, Taiwan, and China.” (S1)

“Teacher always reminds us if you want to be in certain job, you must master your math.” (S5)

“The strength of School A is to be trained to have good attitude through involvement in extra-curriculum. School A is not so good in academic but organizing extra-curricular is good. Cotch has taught me a lot of living skills not from the book.” (S1)

“I feel that skills are more important than knowledge or academic.” (S2)

“School likes to use marks to force us to involve in activities, for example if we did not join the activities we did not get the marks. This is something that I don’t like.” (S1)

“Sometimes, I think if I use the time for extra-curriculum to study, I may get more than I involved in activities.” (S1)
“Teachers like to use ‘force’ method to us.” (S1)

4.9.5 (b) School B

Students seem to be understood why they have to learn mathematics but mathematics teachers are found do not possess this counseling competency in School B.

“Math can train us to have logical thinking.” (S6)

“I never ask myself why I learn math, but I ask myself why I need to come to school.” (S7)

“I don’t know because until now I also don’t know what is my ambition!” (S8)

“I would like to chemical engineer. I need math other than chemistry” (S9)

“I would like to become lawyer, but I worried to be thrown aside” (S10)

“Our teachers never told us that math will be related to our future career or as minimum requirement for us to further study in university.” (S6).

4.9.5 (c) School C

Basically, all the five students have their ambitions and goal of study except S15. Students seem to be understood why they have to learn mathematics without consulting with their mathematics teachers.

“Because I want to be a nutrition specialist, I hope that I can focus on the academic study and not so much influenced by other activities. This is because I come from
single parent family. If I cannot reach my goal, I feel sorry to my mother who is financially supported me. I have to take responsibility to get a good result to help my mother to save money. That is why I said I come to school is a responsibility.” (S13)

I would like to earn a lot of money that is why I choose finance. Because I see my father’s support my elder sister to study very hard. If I want to earn a lot of money, I must understand the money first before I possess it. If I have money, may be I can help to support my younger sister so that my father does not need to suffer. My elder sister graduated from Taiwan and continued study as part time learner in Italy, I see my father works as salesman is very hard to support her. So I don’t want to burden my father.” (S11)

“I hope that by this year I can determine specifically what I want. Now, I can just identify in the area of technology only, have not decided yet.” (S15)

“I would like to get scholarship to go oversea to study. Because I want to be clinical psychologist, the program is very expensive. I don’t want to trouble my father because my family is not so rich, hopefully the scholarship will help me. I also want to help people, so my father wants me to study business management, but I prefer psychology, no matter which one I still can help people.” (S14)

“Until now I still don’t have the direction what I want to be. Money is not a problem to me. Of course if I have the scholarship will be better so that don’t need to spend my own money. But psychology my parents are not allowed because they said I will be jobless.” (S15)

“We are very stressed because of UEC exam this year. Stress is a kind of motivation to me.” (S14)
4.9.5 (d)  School D

School D has its own system to control students’ attendance. The career information is well spread to the students but mathematics teacher is not the main source. Owing to School D is a girl school, they do not have much behavioral problems.

“Yes we don’t need to learn math so deeply in our daily life. We need math just to buy vegetable in market.” (S17)

“I remember my teacher said math definitely will be used in our daily life.” (S16)

“Yes, math will be related to many of the university programs.” (S18)

“Because of we are science stream students, those who are in science stream are good students, so if the exam questions are difficult, all of us will get low marks. Actually the gap between us is not broad.” (S16)

“Our math teacher is our form teacher, she has been teaching us since senior secondary Year 1, she understands us quite well.” (S18)

“We know about our career information through various methods. Our school has education exhibition, the related universities have given us the minimum requirements for all the programs in their universities. So we know that many of the programs that we intend to study, math is the requirement for entry. We all know math is very important.” (S18)

“All the students do not have discipline problem because they are good students and is girl school.” (S18)
“We never absent from our class because all the attendance is taking into account. If the attendance is not good, the credit loss will make us terminated from the school or cannot proceed to the next level.”

“We do not have behavioural problem. We are big girl already, we know how to behave ourselves. Of course studying is something very stressful to me, I like to tease friends which is something very common to us.” (S18)

“When I am stressed of my study, I did not find anybody else. I will listen to music, temporarily forget about math is good enough for me.” (S18)

“I find my mother to share with her my stress.” (S16)

4.9.5 (e) School E

Students seem to have various future plans such as:

“I will continue study mass communication.” (S21)

“I think I will go to Taiwan to study Chinese literature.” (S27)

“Accountant, architect, finance, computer science at oversea...” (S22, S23, S24, S25)

All the students agreed that there is a direct relationship between their ambitions with mathematics. According to the seven students, their mathematics teachers sometimes integrated the importance of mathematics with students’ future career or study when he was teaching.

“Sometimes, in between the class, teacher has mentioned about it.” (S21)
“Yes, like me when teacher teach dy dx, he mentioned is related to architect.” (S25)

“Like me, math is related to finance” (S23)

“Marketing and accountant also related to math.” (S24)

Most of the students stated that they can get this information from various channels. Majority of them started to think of their ambitions since this year. Only S25 started to have the ambition since senior secondary Year 1.

“We have seminar to provide this information, sometimes invite outside people, sometimes is our teacher.” (S27)

“Teacher tells us.” (S25)

“One year about 4 to 5 times, we have this kind of talk or seminar.” (S23)

“I started to have this ambition to involve in finance because of a teacher who has motivated me. Because of I am transferred from other school, sometimes I do not like to come to school. But teacher inspired me.” (S22)

“Counselor provided me guidance, let me see my direction. The counselor did a psychology test on me, and find that myself is suitable in finance.” (S22)

Only S22 had learning problems before. He has wasted the three years of his junior secondary education but now he started to recover since junior secondary Year 3.
4.9.6 Summary of the findings of mathematics teachers’ counseling knowledge

All the principals did not consider counselling knowledge is needed by mathematics teachers as a total since they have a comprehensive counselling support system. Besides, they also pointed out that counselling service is not mathematic teacher’s job specification. The counseling knowledge seems to be irrelevant to all the principals.

However, all the senior assistants have slightly different views compared to their principals. They considered counselling knowledge is important to mathematics teachers but just limited to mathematics subject. They agreed that most of the mathematics teachers are quite well in dealing with students’ learning difficulties and behavioral problems.

In addition, all the mathematics department heads have the same points of view compared to their senior assistants. They considered counselling knowledge is important to mathematics teachers but just limited to mathematics subject. They agreed that most of the mathematics teachers are quite well in dealing with students’ learning difficulties and behavioral problems.

Lastly, all the 27 students who participated in the focus group interview responded that they do not need the counselling service from their mathematics teachers as they are smart and good behavior students. Most of them did not think of seeking help from their mathematics teachers regarding their future career, tertiary education, learning difficulties, and behavioral problems. In short, they did not feel that their mathematics teachers need to possess this counseling knowledge.
4.10 Philosophy and expectation to CIHS educational management

After researcher conducted the in-depth interviews, researcher found that every principal has their own philosophy and expectation to lead their CIHSs. As a result, the following findings show the unexpected results which were not indicated in research objectives at Chapter 1.

4.10.1 School principals’ point of view

“My philosophy in administering school is I want my students to come to school happily and go back with knowledge. In between their time in school is our responsibility to provide knowledge to them. All the theories are actually useless, time is more important and how we treat our students with love and patient to develop is more important than any of the theories.” (P2)

“As I have more than 20 years in the same school that is School C, I do not have a very specific philosophy. At first, I did not want to involve in education because I got the scholarship from the school and the principal at that time request me to help I only come back and give myself five years. However, after five years, I found that education needs an appropriate thinking individual to lead so that students may not lose their opportunities to study. I felt that being educator is very important especially for the time when I was the head of disciplinary board, I found that a teacher can change a student’s life especially those naughty students from misleading to the wrong direction.” (P3)

“Along 12 years when I became principals, many other organizations want to recruit me with the salary more than 30 percent of my current salary. For example, Indonesia and some other CIHS want me, especially Indonesia provides me very attractive salary in USD but I also did not accept. Thus I changed my mind to become entrepreneur and earn a lot of money to become educator. This is because my mother’s teaching that is when you do anything must start to do it until the end. Why I just remain in School C because I start from here. Just like I personally think that those teachers who start from here will continue until the end. I do not like those teachers come from other schools and complain about the former school
problems. Whatever problem that you have, you should solve it, not run away from it.” (P3)

“If you ask me about my expectation on education, I would like to say that education system now keep on changing cannot be stabilized. It should have some foundation to be fixed. We are private and Chinese education we should channel the future direction more accurate so that we can lead to be stronger. I also want students to be not only academically good but also having other skills. Education cannot be selfish, we must share with people. I always like to share my experience with others. I never hide everything on what I have done.” (P3)

“In education, we should not compete among ourselves. If my students want to leave my school, I will ask him why he wants to leave. If he said other school better than this school, I will ask him to go ahead. Likewise other school students want to come to my school, I will ask them to remain in their old school. If not must get leaving school certificate only can come to my school. Once they need the leaving school certificate, they will automatically see the principal. If the principal want them to stay, then let it be. We should not fight among each other in education. Everywhere as long as have Chinese people, we like to fight among ourselves, like basketball, dance organization, Chinese musical team, association and so on. If you ask me my expectation, I would like to say I want to make the good education that can educate good behaviour students for the future. I am not allow my students to be rude to teachers, to educate them a good behaviour so that they will not simply quarrel with their boss when they go to the workplace later.” (P3)

“My expectation in School D is very limited with space. With the limited space, we try to give the best education to our students. Many of the students have family problems that we cannot help them but hopefully they come to school, we are caring with them. The biggest assets that I have are my strong work team and people oriented relationship. I have a strong, tight team just like a family. I am very concern about my teachers that will lead to my teachers are very concern about their students.” (P4)

“I always let my teachers understand about what is Chinese education, philosophy of education. Every Friday we have meeting after school that is the time that information transfer. We have many different level of meeting from subject matter to administration issue teachers got many resources, we also helping teachers to solve
their problems. If my teachers did anything wrong, I will apologize to the parents. I always support my teachers.” (P4)

“The administrative system of School E can be considered as quite good although only has limited manpower. Therefore most of the teachers have to do a lot of tasks other than teaching and do not have conducive working environment due to the shortage of financial support. The size of school is small and do not have sufficient support staff to help in administrative work.” (P5)

“Because of the low number of students in School E, many have suggested to me so that turn this CIHS to career institution or take off the religious philosophy so that it can gain more diversity of students but I refused to do that. My principle is no matter what achievement of the students, once they have graduated from this school has to continue to further study to university. Some students may not take it seriously and think that this is impossible but the principal still keep on promoting his principle that all of his students have to further their study.” (P5)

“My education philosophy is I just focus on the learning process, do not care about output or result. I do not care so much on examination results but care about what the students are going to be is the most important matter. As long as the graduated students can contribute to the society and do not create chaos to the society, that is good enough already. The most important issue in education is the change of students’ behaviour like being a kind person. I always told my teachers that they can do anything in order to improve their students but if it is still fails, it doesn’t matter because this is education. Nurturing is important in education, results is not the efforts of one person. Some graduated students came back to me and expressed regret of not listening to my advice and said to me that I am the best teacher, that is enough as an educational output because this student has been educated. I always advise my teachers that we just spread the seed of love, whether what type of outcomes that we get is not important, do not put too high expectation except those students who are good I never go back to my former schools as an important person to claim for my efforts because my duty is just nurturing whether success or not is not important as long as students felt that I have managed to influence him or her, it is education already.” (P5)

In conclusion, all the five principals gave different philosophy towards education. Most of them emphasized on the learning process rather than the end results. They
strongly believed that education is powerful weapon to create the future human resources with good behavior.

4.10.2 Academic senior assistants’ points of view

“In conclusion, my expectation is the teachers must possess classroom management skills. Besides, teachers have to do reflections for improvement in their teaching.” (SA1)

“My philosophy is we should follow Kong Fu Zi teaching that is teaching never feel tired. The difference between primary school and high school in term of student affair management is in primary school, we are their baby seater, taking care of them but in high school, other than baby seater them we need to be their close friend as well. We have to listen to them and help them.” (SA3)

“My principle in discipline area is to train and educate the students to become a good personality individual. Discipline plays a very important role to promote positive school culture. Once the school culture is good, we will able to produce all rounded students with excellent not only in academic, extra curriculum, and also behavior and attitudes.” (SA3)

“All the CIHSs have different philosophy to manage schools. However most of the schools will follow the needs of society. Every school emphasizes differently, some CIHSs in East Malaysia, just focus on English, they do not have Mandarin medium. Although Dong Zong has provided the guidelines for us to manage but not all the schools will follow. Some schools even directed to a making profit organization. But for School E, our philosophy is more on religious and helping society services. Just like School E, pure science class just has 3 students only we still open a class for them because our intention is not making profit and providing society help and services. Each school normally will base on the initial goal when this school started to develop, to direct the school focus. We also need to consider poor students this school will accept also these students and their school fee will find the financial support from outside for these students. Actually in our Chinese community, many people are willing to give their helping hands for these poor students.” (SA5)
“My expectation to this school is have to maintain the valuable motive of develop this school at the beginning that is religious based and society services. Our philosophy is we do not reject weak students, our aim is not how many A, but develop them to be a useful individual to contribute to the society not creating problems to the society. My hope is more and more quality and young teachers would like to join us to improve the school gradually to be the better.” (SA5)

“To managing a small school to provide service to society is something very valuable. For example, one of my teachers likes to do hiking. Every year, he bring students to hike Gunung Tahan, students learned a lot of things through this hiking activities. So education is not just exam, there are still a lot of things that we can teach to our young generation. Another example, one teacher likes to have musical concert, so every Sunday, where there is no car day at Birch Street, she bring our students to have musical concerts over there. Education should be more flexible, not only focus on academic, should integrated with their interest that only make sense.” (SA5)

In conclusion, all the five senior assistants have indirectly influenced by their principals and followed the same philosophy to manage their CIHSs. Most of them also emphasized on the learning process rather than the end results. They also strongly believed that education is powerful weapon to create the future human resources with good behavior.

4.10.3 Mathematics department heads’ points of view

“My expectation is students’ achievement. Every time school meeting, students’ achievement is our main agenda. We always question about why central and south CIHSs can do better than us. Their internal exams also up the standard of UEC exam. So this is my expectation.” (DH2)

“If you ask me about my philosophy of position as head department, actually I do not learn management before. I hold this position because of my long experience here, know very well about the school situation. I just want my teachers to do as what I do. For example at this time their exam papers should submit, if I can do that
on time why not my team members. If I can close one eye, I will do that. I do not have any expectation because I am not an ambitious person.” (DH3)

“My expectation is I hope that maths in School D will become great one day. Initially I also think that girls’ maths ability may not be as good as boy’s but one of the professor from Taiwan told me that I am wrong. So I hope this school all my girls will keep on improving their maths. I also hope that one day those teachers who are optioned in maths will take over my place as head department because I always feel guilty to hold this position.” (DH5)

In conclusion, all the five mathematics department heads have different expectations compared to their principals and senior assistants. They hoped for better academic results and better teacher quality in the future.

4.10.4 Mathematics teachers’ own views

“I found that education in Malaysia just solve the current problem never see the bigger picture. CIHSs have opened up the opportunities for students to further study to oversea so that they can use what they learn. If they stay in Malaysia, my friend told me that an engineer just do a small task only, not involved in big project.” (T4)

“My expectation is students’ interest. Our major problem is students do not like math. So even we work hard, effective teaching but students cannot follow, reject math. I think the problem is math in primary school is quite boring. Just like what I have observed from my own children. If we want to develop the interest, we still have very long time. I found that the source of students not interested in math is because of the method of teaching in primary school, too much to cover, and teachers are to hurry. I found that primary school syllabus is overflow until students are too full. When it is over flow, it demolishes the interest of the students.” (T5)

“My major problem in teaching math is students do not do their homework. I have to be fierce. My expectation is students have good results.” (T10)
“My expectation is simple. I just want my students to study well.” (T11)

“My hope is students like math because some students are very reject math. I just like them at least try.” (T13)

In conclusion, all the 13 mathematics teachers generally also hoped for better academic results in the future. However, they still blame the elementary mathematics curriculum failed to develop the students’ fundamental mathematical concepts.

4.11. Summary of the Qualitative Results

On the sake of brevity, in this section, results are summarized in Table 4.2. Some typical statements are included below to support the created themes. In addition, the results will be substantiated the particular claims in Discussion section in the following chapter.

<table>
<thead>
<tr>
<th>Competency</th>
<th>Subthemes</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CK</td>
<td>Criteria of</td>
<td>“…must fulfil the criteria of their academic background such as in the area of pure mathematics education, mathematics education or related to mathematics…”</td>
</tr>
<tr>
<td></td>
<td>recruitment</td>
<td>“…optioned math. If not, they also from science stream” \</td>
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<tr>
<td></td>
<td></td>
<td>“…have expertise which is directly related to math” \</td>
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<tr>
<td></td>
<td></td>
<td>“…based on her expertise in teaching math in English” \</td>
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<td></td>
<td></td>
<td>“…have teaching qualification specifically in math” \</td>
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<tr>
<td></td>
<td></td>
<td>“Once they are from science stream normally they know the content and can teach well…” \</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“…optioned in math if not they are from science stream” \</td>
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<tr>
<td></td>
<td></td>
<td>“…try to get those whose options in math.” \</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>“…content knowledge in science stream subjects in UEC are particularly more difficult and high standard compared to other public exams such as O-level, SPM or even slightly higher than A-level or STPM”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I graduated from public university, biology and mathematic” \</td>
</tr>
</tbody>
</table>

293
specialization also found insufficient competency to handle applied math for UEC”
“Students who gained good result in math UEC are confirmed to be excellent but those national school students who scored good result in math of public exam cannot sure that they are really excellent in math”
“Applied math of UEC is very difficult, students found hard to mastering math skills and content”
“…because of the high standards of difficulty.”

| Classroom observation | “…new teachers we will observe them two times a year to make sure they have sufficient content knowledge”
“…teachers who received parents’ complain, we will observe more than 2 times, find out whether they have problems in their teaching especially those have taught the wrong mathematical concept”
“New teachers need to observe to ensure they have sufficient content knowledge to conduct their class…” |

| Insufficiency CK of new teachers | “During our school professional learning meeting, those experienced teachers will teach new teachers how to teach for some difficult topics…”
“I worry the new teacher are lacking of content knowledge although she has math background, this will destroy my students…”
“…upper secondary class I do not let those lack of experienced teachers to teach even not possible for those who are not her options”
“…those although not option in math but they are option in science still better than those new teacher but math is her option”
“…new teachers have a mentor to guide and help them, they also have meeting every week, new teachers will raise their problems and experienced teachers will help them.”
“…new teachers are found to be insufficient of content knowledge to teach math in CIHS unless they are formerly CIHS students.”
“…new teachers are unable to cope with the high standards and will teach the wrong mathematics concepts especially those graduated from public national schools.”
“…new teachers are lacking of strong mathematical content knowledge foundation…they have to struggle a lot to understand the content knowledge before they can teach well.” |

| Lesson plan preparation | “…math teachers at the same form preparing lesson plan together”
“All the teachers have to pass up their lesson plan every week and their leaders will check on their contents” |
“...math teachers have to do their yearly lesson plan also...”
“...any changes in UEC, they have to alert and change their lesson plan according to the new content or question format.”
“Head department or senior assistant will report to me if they found problems in the lesson plan.”

| Various methods used by principals to check on teachers’ CK | “...get feedback from students using computer system...”
“...focus more on students’ homework, exercise, assessments and also have meetings with teachers who are found not teaching according to the contents stated in syllabus”
“Classroom observation is just a formality and does not give us much information about their content knowledge.” |

| PCK The importance of PCK | “Generally experienced teachers do not have problems in CK and PCK but new teachers who have just 1 to 2 years experiences they are quite lacking in PCK.”
“If I want to see teacher’s PCK, I would like to see how much efforts the teacher put in to help the students, the exercise that the teacher give is relevant and sufficient or not.” |

| Training is important to improve PCK | “The teaching professional training in New Era College is relevant but not practical. Our society is keep on changing to information technology, so some content may not be able to practice at the real situation.”
“Of course this kind of training is very directly related to the classroom practice. But the current education, teacher’s PCK is more on applying the skills in career and daily life rather than just providing knowledge.” |

| Classroom observation to verify PCK | “Teaching methods cannot be effective to every class. Teacher has to explain clearly to students so that they can understand. We require new teacher to observe experienced teacher’s teaching and learned from them the PCK.”
“At least more than half of the math teachers are using diversity styles of teaching.” |

| Diagnostic skills of teachers toward weak students | “Teachers explain in a simple way to weak students but they still follow the progress of the topic according to the yearly plan.”
“...will do revision with students to revise and link all the topics together if they are related.”
“...help weak students by providing them some extra basic foundation questions...”
“...give them individual guidance. Normally student may stuck in certain parts of the solution, teacher has to find the source why and which parts made the weak student cannot continue and explain to him.”
“...highlighted the parts that students always did wrongly.” |
<table>
<thead>
<tr>
<th>Competency</th>
<th>Description</th>
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</table>
| Using teaching aids              | “We are using the Taiwan software and found very useful because this software provide interaction with teachers and suitable to students.”  
|                                  | “We bought some software and pedagogical teaching methods from China to assist in PCK such as ‘flipped classroom’ method.”  
|                                  | “If I teach something abstract, I will find something concrete …to let them understand better.”  
|                                  | “We have sufficient teaching aids, advanced technological tool like LED, visualizer save our time do not need to hand copy…”  
|                                  | “If I teach graph, I will find software to assist my teaching.”                                                                                                                                              |
| Classroom management competency  | “…the gap is quite broad. I use the method suitable for moderate students to teach. Only the questions are at different difficulty level.”  
|                                  | “I divided my students into 8 groups. The group leader will be excellent student who can help his team members.”  
|                                  | “I do not like my students discussing when I am teaching, I am very strict in discipline.”  
|                                  | “Experienced teacher don’t have problem to manage class but new teacher has to learn and adjust…”                                                                                                                                                              |
| Assessment of students’ performance competency | “Based on the exam analysis, principal will request teachers to explain if students’ performance is deteriorating. Some teachers have to reconsider their teaching method and make adjustments after the exam.”  
|                                  | “In setting exam questions, teachers have to modify, cannot copy exactly the same as in the reference book. We fixed that all math teachers must use at least 3 reference books to refer.”  
|                                  | “We must understand every year we received different kinds of weak students, their weak levels are something that you cannot imagine, yet teachers can help keep on the improvements in the public UEC exam, it can be proved the abilities of our math teachers.” |
| PPK                              | “My math teachers quite understand their students’ behavior, their readiness to face the exam.”  
|                                  | “I was trained as engineer, not from education. I find difficulty to lead students, they sometimes rebellious, my
main problem is the interaction methods with students.”
“I found that good students are quite arrogant but weak
students are quite sincere. This type of handling students, we
cannot learn from book. Most of the time, I need to use
hand-on experience to handle it.”
“Caring to your students is one of the effective methods.”
“Students need to understand the logic of the formula,
cannot just follow formula without understanding the logic
why…”
“Most of the students like to memory rather than understand
and think about it mathematically.”

| Understanding of students’ learning process | “Different students’ background, different problems. We
have many different countries of students for example,
China, Indonesia, Hong Kong, Taiwan, Nigeria, Thailand,
Korea, Japan, so these international students are different
quality with our locals, in their acceptance of our teaching
method, mastering math skills and knowledge.”
“Most of the math teachers do not have problem to
understand their students psychologically.”
“We have strengthen class. For math, we manage them not
according to their class but according to their
internal exam results.
“The school system now is teacher follows the students for 3
years. I found this system is better because teacher can
understand the students’ learning process development very
well.” |

| Understanding of individual student characteristics | “If you ask me whether I agree or not by understanding my
students will help my teaching, I would say ‘yes’ because
some students do not like teacher to pay too much attention
on them, this kind of students, we have to approach them
personally.”
“There is a big gap in my class. For me, good students
become my small teachers. Because if they are able to teach,
means they can answer the exam questions. Although their
methods sometimes not so comprehensive, at least they have
their confidence if they can teach their friends.”
“I am quite familiar and know very well about my students’
progress because the small number of them.” |

| Organizational knowledge | The gap between Dong Zong and CIHSs
“To my opinion, the gap is quite narrow. I am satisfied with
my math teachers in their organizational competencies to
handle the change of UEC exam format recently.”
“The information from Dong Zong is quite limited. For
example, Dong Zong just provide the exam format, syllabus,
and textbook. However, math teachers’ organizational
knowledge is good. They access internet to get related
information from China and Taiwan website because our


syllabus and content of UEC are derived from China and Taiwan.”
“We try to adapt to the requirement mentioned by Dong Zong. The reference for UEC is very limited so teachers have to create themselves the questions based on the past year questions.”
“The gap between UEC and SPM. SPM allows students to use calculator while UEC not allowed. In case, we do not allow our students to use calculator. We do not have a choice because once the students use calculator they cannot handle UEC questions.

| Knowledge of organization and ecology of the school | “Principal report was stated clearly about the rules and regulations, as well as teachers’ responsibilities. So far, no problem was arisen about teachers regarding their responsibilities”
“Related to right and responsibility, the teacher guidelines have informed us for example students who did not do their homework have to stay back.” |
| Knowledge of the school quality and effectiveness | “We get teachers from various resources although turnover rate is not high but still have turnover.”
“Teachers have to have various abilities, they are not only good in their teaching, their strategies teaching, being leader to lead 40 over students, counselling those students’ attitudes, so forever cannot be perfect.”
“The part that we need to improve is teaching quality. This is because CIHS teachers are not go through professional training while they are recruited.” |
| Knowledge of management, governance, and transparency | “To my opinion, school administration is quite transparent because all our assessment including workbook checking, lesson record, and students’ exam analysis are open to all teachers.”
“We have discussion among math teachers is a common matter. Because math is a tough subject, we cannot solve all the problems, so most of the time we have to discuss among us.” |

<table>
<thead>
<tr>
<th>Counselling knowledge</th>
<th>Competencies in dealing with students’ educational career</th>
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</table>
|                      | “I told my students by learning math enable them to be self-improvement. Senior secondary students know that most of the program will need math as minimum requirement.”
“I told my students that learning math can make them to have logical thinking.”
“I tell my students that learn math will help them in tertiary education even though it may be not their major option but...” |
most of the university programs have indirect relationship with math.”

Competencies in dealing with students’ learning abilities

“These students are weak because they do not have self-regulate learning. So when they reach senior secondary education, they are lacking in expressing skills in writing. The foundation of students is our main concern. Because math cannot read, must practice a lot in their past year questions. Besides, the writing speed is also very important.”

Those students have learning problems, math teachers will settle by themselves. Because of the class size is small most of the remedy or enrichment activities can easily conducted during class hour. The most important teacher must know how to plan for them.”

Competencies in dealing with students’ behavioral problems

“If I found out that the students are lazy, do not pay attention, I will not allowed them to go back home before they finished their homework. Once we do that, very low percentage of students will repeat the same problem. I always let the students learn that they cannot escaping for not doing homework.”

Normally we want students to learn how to responsible to their bad actions. We may want him to do some services as punishment.”

Competencies in consulting skills

“10 out of the 16 math teachers have the counselling competencies. If teacher cannot manage her own class, it is very hard to have quality teaching.”

“I observed our math teachers understand our problematic students through their peers.”

“Our math teachers do not have problems in handling and consulting students. Most of the students are afraid of them. They don’t have the problems like students did not bring text book, sleep in the class, did not pass up homework.”

4.12 Conclusion

In conclusion, all the interviews findings were consistent and no contradicting views from the five different perspectives of principals, senior assistants, department heads, mathematics teachers, and senior secondary education students regarding the five aspects of competence. All the informants regarded PCK and PPK as the most important competence for mathematics teachers because of the high standard mathematics in UEC.
examination. All the informants did not consider the organizational knowledge and counseling knowledge were important to possess by mathematics teachers. On the other hand, results of this study revealed that new teachers and the non-optioned in mathematics teachers were found to be insufficient in CK. New Era College teaching professional training which is an integral part of the Dong Zong Chinese education system enable to serve the needs of the new or non-optioned mathematics teachers in order to develop their competencies in all the five aspects of knowledge. In the next chapter, summaries and discussion would be made in conjunction with the findings. Upon that, recommendation and conclusion shall be discussed.
CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter covers the summary of the research findings, discussion based on the overall results, followed by the implications of the study. In addition, some decent recommendations were made in order to enhance the process of teacher competencies development amongst the significant five professional competencies with the components of knowledge including CK, PCK, PPK, organizational knowledge, and counselling knowledge of COACTIV model specified for the context of mathematics teaching in CIHSs in Penang, north of Peninsular Malaysia. Moreover, research gaps were also identified for future improvement.

5.2 Summary of Findings

The overall findings indicated that CK, PCK, PPK are generally recognized and possessed by most of the mathematics teachers in CIHSs. However, the organizational knowledge and counselling knowledge seemed to be neglected due to the school situations. The findings had been presented in Chapter 4 in answering to the research questions and were highlighted in the summary below:
5.2.1 Content knowledge of mathematics teachers

The CK of mathematics teachers was investigated from principals, senior assistant, mathematics head department, mathematics teachers, and their students. Findings revealed that majority of mathematics teachers in CIHSs have sufficient content knowledge. CK competencies were identified as

(a) Criteria of recruitment

Majority of the principals recruited their teachers according to their academic backgrounds in the area of pure mathematics, mathematics education or related to mathematics. The second choice only will be those teachers from science specialization. Due to the high demands of mathematics teachers in CIHSs, some schools recruited those teachers whose option is not mathematics or sciences but they are interested in mathematics. These are the teachers who will face difficulty in their CK while they are teaching mathematics (P4, DH1, P5). Teachers who are not optioned in mathematics found the contents are too difficult for them and they have to do a lot of preparation as well as seeking help from experienced teachers (T10, DH4, T12).

(b) High standard of UEC examination

The CK of mathematics teachers in CIHSs is extremely important because mathematics is one of the most difficult and important subjects in UEC examination. The high standards of UEC examination need high competency teachers particularly in their CK. The standard of mathematics subject in UEC examination is higher than other public
examinations such as O-level or SPM and even equivalent with or higher than A-level or STPM (P5, P2, P3, P4, T3, T4, T6, T11).

(c) New teachers are found to be insufficient of content knowledge

Generally, findings revealed that most of their new teachers are insufficient in their CK. According to most of the principals, these new teachers are required to develop by their peers or sent for training (P3, P4, P5). P4 was worried about her new teacher may affect her students' mathematics performance because of her insufficient CK even though her specialization is mathematics. All the principals are not allowed new teachers to teach the Year 3 students because they are going to attend to public examination. Senior assistants and mathematics department heads play their key roles to guide and develop new teachers gradually by having weekly meeting, professional learning community activities, classroom observations (SA2, SA4, SA5).

(d) Classroom observation

Majority of the school principals utilized classroom observation as a method to assess teachers' CK and PCK. All the principals have carried out classroom observation two times per semester particularly to new teachers. Classroom observation is being scheduled at the beginning of the academic year (P5). However, those teachers who have received parents' complaint will be observed as well (P2). School D has two types of classroom observation, the first one is experienced teacher observe new teachers, giving comments to help them and the second type is new teacher observes the experienced
teacher's teaching so that new teachers can learn from experienced teachers. According to SA4, she found the second type is more effective compared to the first type.

(e) Lesson plans preparation

All the principals, senior assistants and department heads evaluated their mathematics teachers' competencies related to CK based on their lesson plans preparation. All the five CIHSs have a regular system to check mathematics teachers' quality teaching through lesson plans. School D has formed a mathematic team to prepare appropriate lesson plans together. School A has a lesson report which is filled by class monitor to identify the progress of the lesson. School E has two levels of monitoring system on teachers' lesson plans. The first level is the lesson plans will be checked weekly by the head departments and the second level is the lesson plans will be checked by principal or senior assistant six times per semester.

(f) Teachers' content knowledge in their teaching with different medium of instruction

All CIHSs provided more than two types of mathematics caused the mathematics teachers have to face problems of transferring their CK from different languages. Moreover they are also having problems with limited references. Some of the mathematics teachers have to seek help from CIHSs in East Malaysia, China, Taiwan or Singapore. Even though teachers are facing various content problems but they still managed to accumulate extra questions from various sources and published an exercise
book for all levels (School A), seek help from experts (School D), translated from the contents from national schools (School C and E).

5.2.2 Pedagogical content knowledge of mathematics teachers

Findings revealed that majority of mathematics teachers in CIHSs have used various methods and techniques to shape their teaching and learning process in the classroom, their abilities in classroom management, their planning of learning process, knowledge of student development, their diagnosis skills or competencies towards those weak students, and their competencies on assessment of students' performance. PCK competencies were identified as:

(a) The importance of pedagogical content knowledge

Majority of the mathematics teachers are alert and flexible in using multi-media teaching aids. School A, B, and C are highly equipped with technological teaching aids to assist the teachers in their teaching, for example smart board, visualizer, WIFI and so on. Teachers can assess to internet to find innovative teaching method (DH4). Teachers are found to be using different methods when they are teaching different capabilities of students (T2). Majority of the teachers are practicing not to allow students to copy (T3, DH2, DH3, T6). Most of the teachers possessed a high level of PCK, for example able to explain clearly the mathematical concepts, relate the mathematics questions for each topic with previous topic, and good questioning techniques.

(b) Training is important to improve teachers' pedagogical content knowledge
All the informants agreed that New Era College professional training is able to raise teachers' competence and cope with changing demands to keep abreast of the times. Hence, in-service training or some in-house which provided by the department head (DH1) enables to provide useful reference and guidance on the practical aspects of implementation of mathematics teachers.

(c) Diagnostic skills of teachers toward weak students

Group and individual teachings are commonly used by the mathematics teachers in CIHSs in order to diagnose weak students (S4, T2). Besides, most of the CIHSs are having extra class, strengthening class to improve the students' learning progress. Moreover, teachers prefer to ask the good students to become small teachers to teach their friends who are weak. Teachers found that by using small teacher method is the win-win solution whereby the small teacher becomes excellent student while the weak students found to easily accept their friend's teaching method than their teacher (T3, S5, DH2, S4, S3).

(d) Competency in using teaching aids

School B is using software from Taiwan and found to be very useful and the school has two multimedia classes with advanced technology like smart board (P2). School E bought software from China to assist teachers in their teaching method so called as 'flipped classroom' (P5). All the classrooms in School C are equipped with visualizer and smart board. Most of the teachers are able to prepare ppt, download movie or video clip in their teaching (DH4). Some teachers like to use something concrete that they have to those students cannot think abstractly (T3, S8, S14, S18, S12).
(e) Classroom management competency

Majority of the mathematics teachers can manage their classroom very well because they are the form teachers and some of them are discipline teachers as well. They are strict and control the class very well. If the gap of the class is broad, teachers use the method suitable for moderate students, only their questions are at different level of difficulty (T5, T9).

(f) Assessment of students’ performance competency

Most of the teachers have to modify their examination questions from reference book then send to department heads or senior assistant for checking before printing. All the CIHSs have four internal examinations namely two major and two minor examinations. The extra class in School A is used for doing extra past year question practice. The change of UEC examination format since last year, all the CIHSs have given the obligation to the mathematics committee to make the necessary adjustment (P3, SA2, SA1, DH1, DH4). In School A, all the examination papers will be collected by the department head and then submit to administrative affair leader and put them in e-class. Any of the students can access to e-class to see the past years examination papers including the answer. The roles of examination are important for teachers to decide the method that they teach.
5.2.3 Pedagogical / psychological of mathematics teachers

The PPK was assessed from the knowledge of mathematics teachers on students’ learning process and individual student characteristics.

(a) Understanding of students’ behavior

Majority of the mathematics teachers have eight to nine periods per week so they can understand the students very well and have good relationships. Different mathematics teachers used different ways to know about their students’ learning behavior such as by looking into their homework (T13), focus on their exercise (T11), study their psychology (T4 and T6), set some regulation to attract their attention (T12). Teachers quite understand the students’ behavior, their readiness to face the examination (DH2). However, DH3 who is trained as engineer found himself hard to interact and understand students’ thinking and feeling. Almost all the mathematics teachers using Whatapp to interact and help their students thus understand their learning behavior.

(b) Understanding of students’ learning process

CIHSS students need teachers to understand their learning process more than national school students. This is because of CIHSSs are having shortage of teachers and they do not have SOP to follow (P4). Generally, teachers can understand well about their students’ psychological development because they have very closed relationships between teachers and students. Students are found to be very proactive in learning mathematics (SA3). School A is the only school has quite a lot of international students who come from
China, Indonesia, Hong Kong, Taiwan, Nigeria, Thailand, Korea, and Japan. These international students are different quality with local students. Teachers have to use different language to explain to these international students (DH1). Most of the time, teacher has to make sure the weakest one still can cope with the particular topic (T3). Generally, teachers have to finish the syllabus between June to July in order to have enough time to do revision with students (T3, T5, T6).

(c) Understanding of individual student characteristics

Most of the mathematics teachers prefer to follow up the students since Year 1. Mathematics teachers must understand students' psychology especially when they meet with mathematics problems. They want to solve the problem quickly so teacher need to response to them (T3). Teachers give more challenging questions to good students, provides opportunities for them for competition while teachers have to simplify the questions to weak students (DH2). Most of teachers and students share their feelings through Whatapp so teachers know their students' characters very well (SA1).

5.2.4 Organizational knowledge of mathematics teachers

The organizational knowledge was examined based on the mathematics teachers' knowledge of institutional framework, management, governance and transparency, the organization and ecology of school, and school quality and effectiveness.

(a) The gap between Dong Zong and CIHSs
The gap between Dong Zong and CIHSs is not serious (P1 and P2). School still can match with Dong Zong requirements. Dong Zong has carried out research together with senior teachers, work closely with internal and external experts to remain the high quality standard of UEC examination (P1). However, P3 disagreed with too high standards of UEC because students cannot do well in UEC examination affecting them for getting scholarship. The information from Dong Zong to CIHSs is quite limited particularly in teaching methods, advanced contents other than examination format, syllabus and text book (SA1). The gap between UEC and SPM for using calculator in the examination UEC not allowed but SPM allowed (SA4). Dong Zong is keeping on modifying the text books caused the uniqueness of the high standard has lost (DH1).

(b) Knowledge of the organization and ecology of the school

All the principals (P1 to P5) admitted that their mathematics teachers know their responsibilities such as must finish their syllabus, cannot beat students, cannot do other works while they become proctors, etc. Teachers know about their responsibilities through general meeting and small group meeting which is conducted every Saturday (SA2). Basic responsibilities such as working on time, setting examination questions and submitting for checking are generally understood by all the mathematics teachers (SA5). Teachers know about their right and responsibilities through teacher guidelines (DH5).

(c) Knowledge of the school quality and effectiveness

P1 put School A quality and effectiveness as 7 marks mainly because she still hopes for the improvement about quality teachers and students. P2 evaluates School B
quality as 7 marks and the aspect that needs improvement is academic performance, P3 assesses School C quality as 6.5 to 7.0 marks because of the current teachers still fail to fulfil multi-tasks and have various abilities. They are not only good in their teaching, their teaching strategies but also must be a leaders to lead 40 over students, counselling their students, discipline students’ attitudes and so on. P4 determines the school quality as 8 marks because the School D has limited of space and teacher quality still can be improved. P5 gives School E quality and effectiveness as 7 marks because the school still has room for improvement.

(d) Knowledge of management, governance, and transparency

CIHSs have quite transparent leadership. Any new information or training provided by Dong Zong will be put on the Whatapp group to inform every teacher (DH2). Mathematics teachers are found to have least knowledge in this area. School administration is quite transparent in School A because all the assessment including the workbook checking, lesson record, students’ examination analysis are informed to all teachers.

5.2.5 Counseling knowledge of mathematics teachers

The counseling knowledge was examined based on the mathematics teachers’ competencies in dealing with students’ educational career, students’ learning difficulties, behavioral problems, and competencies in consulting skills. Majority of the principals, senior assistants, department heads, and even mathematics teachers did not perceive the
counseling knowledge as competencies needed. This is because CIHSs have provided counseling support system.

(a) Competencies in dealing with students' educational career

According the school administrators, students should get their academic study information through counseling department. Ministry of Education fix the ratio as 1 counselor to 500 students. All the CIHSs have their professional counselor. Besides, CIHSs always conduct seminar regarding further study or future career and also carry out talent assessment to identify students strengths. In general, mathematics teachers will only need to highlight the relationships of mathematics to students' future career is sufficient. Other detail information about educational career should leave it to the counsellor. On the other hand, school administrators (P5 and SA5) from School E suggested that parents counseling is very much needed. This is because parents are not encouraging their children to further study but insisting them to work after graduating from high school. However, department heads and teachers are always being questioning by their students about why they should learn mathematics. Students thought that mathematics is no connection with their future career. As a result, teachers need to explain to students not only to make them understand the relationship between mathematics and their future careers but also the requirement to tertiary education institutions.

(b) Competencies in dealing with students' learning difficulties
Most of the CIHSs do not have many students with learning difficulties particularly in science stream. However, every CIHS has their procedures to handle students with learning difficulties. Firstly, mathematics teacher as a subject teacher will try to solve the problems. If subject teacher cannot solve it, he or she will refer to form teacher. If form teacher cannot solve the learning problems, mathematics teacher will refer to discipline board. The final referee will be school principal. Most frequently learning difficulties that the CIHSs faced was did not do homework (SA1 to SA5). Department heads (DH2 and DH3) and some mathematics teachers (T3, T5, T9) have the same views regarding students' learning disabilities are caused by the primary school foundations. Since UEC mathematics is very difficult, students cannot cope and have to struggle when they start to join junior secondary Year 1.

(c) Competencies in dealing with students' behavioral problems

Generally, mathematics teachers that researcher interviewed are strict character who the students are afraid of. They are either form teachers or discipline teachers so they do not have to deal with students' behavioral problems. However, most of the mathematics teachers are found to have competencies in dealing with their students' behavioral problems. T3 pays more attention make the students more proactive when he meets with this kind of problem. T13 is a strict teacher and most of the students are scared of him. He asked students to buy a new textbook if they did not bring the text book. DH2 was a discipline teacher before so he did not have this problem at all.
(d) Competencies in consulting skills

Those experienced mathematics teachers are found to possess this consulting skill. Students (S6 to S10) seem to be understood why they have to learn mathematics and its importance for their future career but their teachers (T4 to T6) are found do not possess this consulting skills.

5.3 Discussion

The main objective of this study is to explore mathematics teachers’ professional competence in terms of CK, PCK, PPK, organizational knowledge, and counseling knowledge in CIHSs in Penang. Findings of the study revealed that the vital mathematics teachers’ professional competence is PCK, followed by CK and PPK. These three components of professional competence can be acquired through formal training and reflected in their teaching experience. The findings confirmed the relevance of mathematics teachers’ recruitment criteria set by CIHSs in order to upgrading high quality teaching, in return improve student learning. This result is supported Koon’s (2015) findings as teachers are one of the most important factors in school education. The quality of mathematics teacher will determine the success or failure of educational reforms.

In addition, findings of this study can be guidelines for CIHS administrators on which components of professional competence to focus so that the mathematics subject will not be the lowest performance among all the 20 subjects in UEC-SML examination
and also CIHSs in Penang will not performed below the national level in terms of excellent results in future.

The competencies and structural issues related to mathematics teachers cannot be over looked in the development of CIHS education. As shown in the findings of this study, the current qualifications and trainings of mathematics teachers in CIHSs are devoting to guide mathematics teachers to become professionally competent and personally committed in their teaching career, and uplift the professional status of CIHSs in society too.

Results of the study showed that PCK is the most important competency out of the five key elements of competency. In order to upgrade this PCK competency, New Era College should take the responsibility to hold various educational courses that related to PCK competency such as diagnostic skills of mathematics teachers toward weak students, competency in using teaching aids, classroom management competency, assessment of students’ and performance competency. This result found to be in line with the past research findings (Berliner, 2001; Woolfok Hoy et al., 2006; Butler, 2007). Besides, results also showed that the importance of cooperation among mathematics teachers of CIHSs particularly in helping the new teachers to improve their PCK. As a result, school administration should organize relevant activities in promoting the interactions and cooperation among mathematics teachers.

Despite the importance attributed to mathematics teachers’ knowledge of content, the understanding of how the learning opportunities available during their professional
training in New Era College is still limited. CK as a prerequisite for PCK (Darling-Hammond, Wei, Andree, Richardson and Orphanos, 2009). PCK implies a transformation of subject-matter knowledge (CK), so that it can use effectively and flexibly in the interaction between mathematics teachers and students in the classroom (Shulman, 1987). In the teacher knowledge literature, there is some consensus that the degree of conceptual understanding of the respective content provides the scope for PCK development (Baumert et al., 2010; Friedrichsen et al., 2009). However, strong CK does not necessarily lead to the development of PCK (Lee, Brown, Luft, & Roehrig, 2007). Results revealed that the new teachers who are specialized in mathematics do not possess PCK but their CK found to be sufficient. This result found to be in accordance with past research findings as indicated above.

Furthermore, findings of the study are found to supported by the theories of Shulman (1986, 1987), Richardson (1996), and Schoenfeld (2011) as mathematics teachers’ competencies have to encompass cognitive abilities and also affective-motivation characteristics. This implies that mathematics teachers’ professional competencies including CK, PPK, and PCk will make up of their cognitive abilities while belief about mathematics and the teaching and learning of mathematics or organizational knowledge as well as professional motivation and self-regulation or counseling knowledge will make up their affective motivational characteristics. On this line of reasoning, findings of the study indicated that the suitability of COACTIV model in assessing mathematics teachers’ professional competence.
Results showed that the CK of the mathematics teacher differed significantly according to their specializations. Consequently, mathematics or science education in tertiary education has affected the development of CK. Previous studies (König, Blömeke, Schmidt, Hsieh, 2011; Vose et al. 2011) supported this result. Although some differences between mathematics teachers are dependent on their years of teaching experiences and the training they involved at university prior to their academic teacher training. For example, whether they are experts in mathematics subject matter or experts in educational sciences, demonstrated that PCK is more involved in competence-based education than their subject expert colleagues within their training. This result is in accordance with Struyven and Meyst’s (2010) finding.

Respondents from principals, senior assistants, and mathematics department heads, and mathematics teachers seemed to value academic achievement above the ‘upbringing’ dimensions of the education process, such as PPK is more concerned on students’ personal and social development. Pantić and Wubbels (2010) interpreted this as the product of the long established disconnect between schools and teacher education programmes predominantly based on subject discipline. However, result showed students’ are more concerned about the importance of PPK of mathematics teachers to develop them in all rounded perspectives rather than too examination oriented.

Result showed that classroom management is a common issue for new teachers because they need to establish control over the learning environment before any lessons can be carried out effectively. In addition, result also indicated that classes that are not
managed well will generally lead to student discipline problems and this can inhibit effective instructional approaches from occurring. This result is supported by previous studies (Freiberg & Driscoll, 2005; and Page, 2008). However, it is interesting to note that from the interviews of mathematics department heads and mathematics teachers themselves are very clear about the interrelationship between counselling knowledge, classroom management, and PCK. Most of them expressed their views of competence characterized by managing the class through disciplining the students. They also pointed out that the act of handling and managing students’ behavioral problems will directly lead to teachers’ confidence in their PCK particularly to new teachers. This will enable new teachers using correct pedagogical methods to engage students in their learning, cater to differing abilities of students and make the lessons interesting.

Result showed that organizational knowledge found to be less capacity but still it is still significant to possess. If mathematics teachers do not have a system for giving students their assignments especially CIHS students are taking more than one public examinations, then classroom disruptions will occur and an effective classroom system will not in place. As a result, mathematics teachers should provide students with the opportunity to learn the key lessons that reinforces the good organizational skills before the consequences of their behavior.

In the knowledge-based economy today, where knowledge progresses at breakneck speed, there is a need for mathematics teachers in CIHSs to be cognizant of the rapid changes in knowledge so that the content that is being delivered not only relevant but also diversity. Qualitative findings from the five different perspectives indicating mathematics subject in UEC examination is extremely difficult. Results of the study revealed that it is
paramount that mathematics teachers must possess high level of CK, PCK, and PPK competencies to enable the teachers to highlight the relevance of classroom learning to what is happening in the external environment. This result found to be in accordance with Tan (2015). According to Tan, there are three progressive challenges to accomplish such as teacher needs to make CK visible to students, make teachers' thinking visible to students, and students' thinking visible to themselves as well.

Results of this study indicated that there were differences between competences like CK, PCK, and PPK and found to be the most important competency among all the five competencies. This implies that teacher as a guide to learning (PCK) and development (PPK) and teacher as a subject expert (CK) are the competencies in the degree are the most often highlighted by their immediate leaders including principals, senior assistant, and mathematics department heads. The results are found to be consistent with the past research findings (Blömeke et al., 2014; Kaiser et al., 2017; Kleickmann et al., 2012; Krauss et al., 2008; Tattö et al., 2012).

In addition, results also revealed that the appropriateness of existing mathematics teacher competency standards and their use in practice in CIHSs was identified by utilizing COACTIV model. At a first assumption, it was identified that there is still a quality gap between the leaders. For example, all the principals never taught of mathematics teachers need counselling knowledge since they have a comprehensive counselling support system. Besides, they also pointed out that counselling service is not mathematics teacher's job specification. This competency seems to be irrelevant to all the
principals. However, there were a totally different points of view from senior assistant and mathematics department heads. They considered counselling knowledge is important to mathematics teachers but just limited to mathematics subject. They agreed that most of the mathematics teachers are quite well in dealing with students' learning difficulties and behavioral problems.

Results also indicated that training for the mathematics teachers on the job is extremely important to improve mathematics teachers' competencies particularly the new teachers. Teacher training at the service of the CIHS is still in its infancy (Wong, 2015). Further development is required to develop a training programme that is more comprehensive compared to existing professional training provided by New Era College to satisfy the long-term needs. Accumulated experiences and insights would enable fine-tuning and upgrading so that the system becomes more effective in helping mathematics teachers to cope with the ever-changing scenario of Chinese education as well as fulfilling the high standards and quality of UEC examination. This is because the main principle of Dong Zong to remain the high standards and quality of the UEC examination is to be accepted as a qualification for direct admission to an increasing number of foreign universities in such countries as Australia, Britain, Canada, China/Hong Kong/Taiwan, New Zealand, Singapore, and the United States of America (Wong, 2015). Moreover, CIHS graduates have been worthy of their credentials and have performed well in foreign universities (Academiatutorials.blogspot.com., 2010).
Despite official indifference, CIHSs constitute an important community project that is dedicated to nurturing the talents of the young (Wong, 2015). Over the years, the need for quality and high competencies teachers to handle the high standards of UEC examination particularly in mathematics has become indispensable and the pressure for a constant supply of such teachers is escalating. However, findings indicated that CIHSs are facing problems to recruit qualified mathematics specialization which in turn caused insufficient competencies in CK, PCK, and PPK. According to P5, it is hard to employ science teachers compared to art stream teachers because most of the science graduates are not interested in teaching compared to arts graduates. This is further supported by DH3 as “...my academic background is not education. I was trained as engineer. My main problem is the interaction methods with students. ...So I find difficult to lead students. Students sometimes rebellious, I feel quite hard for me to handle.”

Results from senior assistants, mathematics department heads, and mathematics teachers themselves indicated that the organizational knowledge was found to be so much needed and they have to depend on foreign references and materials. Viewed from this perspective, Dong Zong has to provide relevant training programme of CIHS mathematics teachers in Malaysia as a development in the right direction. The CIHSs in future direction should have to reduce their dependence on foreign resources or materials. Equally significant, the training programme has put in place a workable system of training that has the potential to meet the regional needs of Chinese education in general and mathematics education in specific.
Findings showed that a more experienced teacher find it easier to transform teaching and to teach creatively, innovatively and knowledgeably. Generally, most of the principals have no confidence for new teachers to have sufficient competencies and knowledge and prove to be harder for a new teacher to starting out particularly in mathematics subject. Moreover, in the current Malaysian norm of ‘spoon-feeding’ type of teaching that embraces a drill and practice approach for examination (Raja Musa & Nik Yusoff, 2000) is longer relevance in current PCK which emphasizing on learner-centered teaching. Results from the students’ perspective indicated that teaching mathematics emphasizes conceptual understanding and provides opportunities to students will assist them to think critically, solve problems and make meanings of their learning. This finding is supported by Feiman-Nemser (2001).

Findings revealed most of the experienced mathematics teachers suggested ‘small teacher’ method, for example, to one that engages students in open-ended problems, accepting different answers, allowing students to struggle with confusion and at the same time managing a productive discussion. Teachers are found to plan by analyzing the subject material, devices steps to provide clear explanations, considers a strategy or uses teaching aids that can better clarify the information, and decides on the best assessment. This finding is in accordance with Pauline Goh’s (2011) findings.

Teaching is a complex undertaking and not easily defined. However, it is found that the competencies promoted by Baumert and Kunter’s (2013) COACTIV model are
somewhat rigid and less prescribe able in actual practice in CIHSs particularly in organizational knowledge and counselling knowledge. The underlying conception of competent teaching emphasizes the importance of perceived action and decision making on the part of teacher. For example, question pertaining to managing class discipline, teachers are capable of implementing classroom management based on the school’s rules, undertaking appropriate action on negative student behavior, and referring the case of a severe discipline to discipline teacher or counselor or form teacher seem to be irrelevance in the competence contexts of CIHSs.

Finally, the overall results of the study have successfully reinforced the COACTIV model as the subject-specific sub-competency encompassing the five key competencies of mathematics teachers, namely CK, PCK, PPK, organizational knowledge, and counselling knowledge. The results showed a predictive validity regarding the level of cognitive activation. Therefore, in addition to the five areas of competencies, constructivist beliefs, teaching-related enthusiasm, and aspects of diagnostic skills, another facet of teacher professionalism relevant to aspects of instructional quality also being identified in the framework of COACTIV. This result is found to be parallel with theories that related to mathematics teacher competencies from the experts such as Döhrmann et al. (2012), Richardson (1998), Shulman (1986, 1987), Schoenfeld (2011), and Weinert (2001).
5.4 Implications

Findings of the study are successfully provided some practical implications for CIHS management team to improve their CIHS performance at national level. The following are the implications of this study. First of all, the competency issue of mathematics teachers for these CIHSs shall be complied to national educational policies. All mathematics teachers should be trained in-service within two years or else their service will be terminated. The scope of training shall include all the five components of professional competence namely CK, PCK, PPK, organizational knowledge, and counseling knowledge as stipulated in COACTIV model.

Secondly, the principals and senior assistant who lead the CIHSs shall also be attending advanced course of school development planning similar to the Local Education Authorities (LEAs, UK) which intended to increase efficiency, improve the quality of teaching and learning and promote the accountability and responsiveness.

The management of school shall be well organized and run by a group of professional preferred to have good knowledge as compared to business entrepreneurs. We found some head teachers have the full autonomous authority over the whole board of directors of school. Group administration in most cases are more superior than individual to avoid favoritism. A good team of CIHS management will have the capabilities to improve and promote teachers’ competencies systematically.

Private or CIHS teachers are allowed to attend government teachers training institutions. To achieve more quality teachers and hence competition among teachers will further improve the standard of valuable asset of the nation in education. Most of the more advance countries in Asia do assist private institutions in term of providing funding
to improve their educational system. The government should subsidize small percentage of the spending to the learning institutions promote professional development of teachers for all private or independent schools.

The findings of this research imply that teaching in CIHSs is about nurturing a future generation of strong thinkers and innovative problem-solvers in order to be mature, responsible, and proactive citizens. Such high demands call for those entering teaching profession particularly in CIHSs to have deep passion and commitment and must develop requisite competencies including CK, PCK, PPK, organizational knowledge, and counseling knowledge to achieve the CIHS mission and Dong Zong's goal. As a result, mathematics teachers have to develop a strong sense of teacher identity in terms of being proud of upholding their profession. The essence of being quality mathematics teachers should seek out constant opportunities to level up their knowledge and skills and to improve their standards of practice, so as to be able to offer the best quality of learning to their students (Tan, 2015).

On this line of reasoning, mathematics teachers have to constantly improve on their professionalism. Teachers comprehend the need to have control over their work and to have personal decision making authority (Pearson & Moonmaw, 2005) if they are going to be lifelong learners and effective in the classroom. Besides, teachers ought to have the flexibility and responsible independence to make decisions that help to improve their students’ learning.
The results of this study have implications for both teacher education and educational policy. The study shows that there are a multitude of ways that mathematics teacher in CIHS to add up and call the conceptions of competence. Teacher educators can use principals, senior assistants, mathematics department heads, mathematics teachers, and students’ perspectives of their competency to support and to extend pre-services’ and other subject teachers’ understanding of the teaching profession. The results of this study can be used for the professional development of in-service teachers and to be inculcated into any new teacher education curriculum in New Era College. Results of this study can be assumed by Dong Zong to set up the educational policy related to measurement of teacher competence in CIHSs.

Departing from the question of whether the professional competencies of teachers are more cognitively oriented rather than more situated in character as mentioned by (Kaiser et al., 2017), this implies future studies have to implement different theoretical frameworks and assessment instruments based on different paradigms of mathematics teachers’ professional competencies. In other word, how and to what extent both research paradigms have enriched each other should be the future practices. Thus, the generalizability of the results of this study can be strengthened and research comes closer to the actual performance of mathematics teachers in the classroom, integrating both perspectives on school leaders’, policy makers’, and mathematics teachers’, the cognitive and the situated, and providing a more comprehensive view of teachers’ professional competencies and activities.
5.5 Recommendations

5.5.1 Recommendations based on the research findings

Teaching professional training is increasing important and driven by the wheel of change of the information age. As a result, researcher would like to recommend to the Education Affairs and Teaching Personnel divisions of Dong Zong to design and manage the following training program. The scope of the training program should cover the following aspects:

(a) Training to new teachers: to assist them to grasp the five basic professional teaching competencies.

(b) Subject training: to improve teaching competencies of non-optioned teachers through the competent use of teaching materials and methods.

(c) Professional training for form teachers: to raise the professional quality and performance of form teachers through short-term and intensive training courses.

Since most of the mathematics teachers in CIHSs are form teachers as well.

(d) Management training for principals, senior assistants and department heads: to provide short-term training programs in co-operation with relevant organizations in China or Taiwan for the purpose of upgrading the limited teaching materials that faced by mathematics teachers in CIHSs.
5.5.2 Recommendations for future research

This research is an exploratory case study. In view of that, the implication of the findings and recommendation of this study were most pertinent in the context of the mathematics teachers’ competencies in the CIHSs. This study managed to provide deeper knowledge and rationale for some happenings in the focus areas. It is recommended that future researches to be carried out based on the outline in this study and attempt to establish a framework or move ahead from this echelon. It can also cover a wider scope or attempt to a different methodology in future research. There are several alternatives in which future researches could be carried out. The suggestions are:

i) Instead of conducting research by case study in five CIHSs, future studies could be extended to cover more CIHSs in a regional area, or by comparing two different high schools from private and public sectors. Meanwhile, it can be conducted for all subjects in the CIHSs, Cambridge A-Level, IGCSE programs, etc.

ii) Longitudinal studies to measure differences in the competencies, both from the perspectives of administrators and students, over a few semesters period, preferably from the commencement until the completion of their studies. Therefore, it would enable measurement for any significant improvement in the skill levels or otherwise. In this case, the methodology can be switched to quantitative research method or using mixed methods.
Different research methodology and sampling methods could be applied in future researches. For example, online survey questionnaire could be sent to all CIHSs in a state or the whole country by means of random sampling, stratified or cluster sampling methods to gather data that could be generalized for all.

5.6 Conclusion

This case study acknowledges the views on five aspects of competence of mathematics teachers from the five perspectives of informants who have direct relationships with mathematics teachers including teachers themselves. It was an attempt in conceptualization of the teaching process and levels of achievement in essential competence aspects namely CK, PCK, PPK, organizational knowledge, and counselling knowledge. The aspects and criteria to be investigated were derived from COACTIV model for mathematics teachers. The study enables the researcher to report the findings more confidently and convincingly through various perspectives of research data triangulation.

As a summary, the contributions of this study not only emerge on the mathematics teachers, but inclusive of professional training of mathematics teachers and their direct leaders, better mathematics education quality and higher reputation for a prestige CIHSs. In the mission of embarking to greater pinnacles, there are guaranteed to be challenges and some kinds of demands along the way. To fully realize the targets, the CIHSs and
their staff should be prepared to be persistent, strong, and attentive in the path towards optimum results in the area of mathematics teacher competencies so as to meet the community, society, and nation's needs.
References


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Appendix A

Interview Protocol

In-depth Interviews with 5 principals, 5 academic senior assistant principals, and 5 science and mathematics department heads from 5 CIHSs

1. To your opinion, to what extent do your mathematic teachers possess the mathematic content knowledge (CK)?
   a. Teaching related aspects:
      - Curriculum and lesson planning (Content including mathematical concepts and operative command of the mathematical content)
   b. Learning process-related aspects
      - Teachers’ actual instructional practice (Content including mathematical concepts and operative command of the mathematical content)

2. Based on your supervision, to what extent do your mathematic teachers possess the pedagogical content knowledge (PCK)?
   a. How mathematic teachers shape their teaching and learning process in the classroom?
   b. How about their abilities in classroom management?
   c. Their planning of learning process?
   d. Their knowledge of student development?
   e. Their diagnostic skills or competencies toward those weak students?
   f. Their competencies on assessment of students’ performance?

3. From your observation, generally to what extent mathematic teachers in your schools have this pedagogical/psychological knowledge (PPK)?
   a. Knowledge of classroom management
   b. Knowledge of teaching methods
   c. Knowledge of classroom assessment
   d. Knowledge of students’ learning process
   e. Knowledge of individual student characteristics

4. What are your opinions related to mathematic teachers’ organizational knowledge?
   a. Their knowledge of education system and its institutional framework?
   b. Their knowledge of management, governance, and transparency?
c. Their knowledge of the organization and ecology of the school; the legal form of school; the rights and responsibilities of students, parents, and teachers, and the role of school management?

d. Their knowledge of school quality and effectiveness?

e. Their knowledge related to theories of schooling?

5. Do you think that most of your mathematic teachers have sufficient counselling knowledge? If yes, what are the areas they generally perform? If not, what are the areas that they are lacking of?

a. Their competencies in making upcoming decisions at critical points of their students' educational career?

b. Their competencies in dealing with students who have learning difficulties?

c. Their competencies in dealing with students' behavioural problems?

d. Their knowledge related to whom (institutional partners: principals, student affair senior assistant principals, counsellor, head department, or senior teachers) should they consult when they make decisions (e.g. psychological or remedial services, child guidance centres, or social services)
Appendix B

Interview Protocol

Focus group Interviews with 10 mathematic teachers from 5 CIHSs

1. Do you possess sufficient mathematic content knowledge (CK)? Having any problems in these matters like:
   a. Teaching related aspects:
      - Curriculum and lesson planning (Content including mathematical concepts and operative command of the mathematical content)
   b. Learning process-related aspects
      - Teachers' actual instructional practice (Content including mathematical concepts and operative command of the mathematical content)

2. To what extent do you possess the pedagogical content knowledge (PCK)?
   a. How you shape your teaching and learning process in the classroom?
   b. How about your abilities in classroom management?
   c. Your planning of learning process?
   d. Your knowledge of student development?
   e. Your diagnostic skills or competencies toward those weak students?
   f. Your competencies on assessment of students' performance?

3. Generally, to what extent you have this pedagogical/psychological knowledge (PPK)?
   a. Knowledge of classroom management
   b. Knowledge of teaching methods
   c. Knowledge of classroom assessment
   d. Knowledge of students' learning process
   e. Knowledge of individual student characteristics

4. How about your organizational knowledge?
   a. Your knowledge of education system and its institutional framework?
   b. Your knowledge of management, governance, and transparency?
   c. Your knowledge of the organization and ecology of the school; the legal form of school; the rights and responsibilities of students, parents, and teachers, and the role of school management?
   d. Your knowledge of school quality and effectiveness?
   e. Your knowledge related to theories of schooling?
5. Do you think that you have sufficient counselling knowledge? If yes, what are the areas that you generally perform? If not, what are the areas that you are lacking of?
   a. Your competencies in making upcoming decisions at critical points of your students' educational career?
   b. Your competencies in dealing with students who have learning difficulties?
   c. Your competencies in dealing with students' behavioural problems?
   d. Your knowledge related to whom (institutional partners: principals, student affair senior assistant principals, counsellor, head department, or senior teachers) should you consult when you make decisions (e.g. psychological or remedial services, child guidance centres, or social services)
Appendix C

Interview Protocol

Focus group Interviews with 25 students from 5 CIHSs

1. Do your mathematic teachers possess sufficient mathematic content knowledge (CK)? Having any problems in these matters like:
   a. Teaching related aspects:
      - Curriculum and lesson planning (Content including mathematical concepts and operative command of the mathematical content)
   b. Learning process-related aspects
      - Teachers’ actual instructional practice (Content including mathematical concepts and operative command of the mathematical content)

2. To what extent do your mathematic teachers possess the pedagogical content knowledge (PCK)?
   a. How your mathematic teachers shape their teaching and learning process in the classroom?
   b. How about your mathematic teachers’ abilities in classroom management?
   c. Your mathematic teachers’ planning of learning process?
   d. Your mathematic teachers’ knowledge of student development?
   e. Your mathematic teachers’ diagnostic skills or competencies toward your classmates who are weak in mathematic subject?
   f. Your mathematic teachers’ competencies on assessment of students’ performance?

3. Generally, to what extent your mathematic teachers have this pedagogical/psychological knowledge (PPK)?
   a. Knowledge of classroom management
   b. Knowledge of teaching methods
   c. Knowledge of classroom assessment
   d. Knowledge of students’ learning process
   e. Knowledge of individual student characteristics

4. How about your mathematic teachers’ organizational knowledge?
   a. Their knowledge of education system and its institutional framework?
   b. Their knowledge of management, governance, and transparency?
c. Their knowledge of the organization and ecology of the school; the legal form of school; the rights and responsibilities of students, parents, and teachers, and the role of school management?
d. Their knowledge of school quality and effectiveness?
e. Their knowledge related to theories of schooling?

5. Do you think that your mathematic teachers have sufficient counselling knowledge? If yes, what are the areas that they generally perform? If not, what are the areas that they are lacking of?
   a. Do your mathematic teachers able to discuss with you about your educational career in the future?
   b. Do your mathematic teachers can solve the problems with those students who have learning difficulties?
   c. Are your mathematic teachers able to deal with students' behavioural problems? How they deal with those problems? Tell your experiences.
   d. Do your mathematic teachers consult with any other school partners like principals, student affair senior assistant principals, counsellor, head department, or senior teachers to help when they make decisions (e.g. psychological or remedial services, child guidance centres, or social services)?