

**TEACHER COMPETENCY IN CHINESE  
INDEPENDENT HIGH SCHOOLS IN PENANG**

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**TEACHER COMPETENCY IN CHINESE  
INDEPENDENT HIGH SCHOOLS IN PENANG**

by

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## LIST OF ABBREVIATIONS

AST	Academy for Singapore Teachers
CIHS	Chinese Independent High School
CK	Content Knowledge
COACTIV	Cognitive Activation in the Mathematics Classroom & Professional Competence
DH	Mathematics Department Heads
GCSE	General Certificate of Secondary Education
IEA	Evaluation of Educational Achievement
IGCSE	International General Certificate of Secondary Education
MTCS	Mathematics Teachers' Competencies Scale
MTS	Malaysian Teacher Standards
P	Principal
PCK	Pedagogical Content Knowledge
PPK	Pedagogical/Psychological Knowledge
PT3	<i>Pentaksiran Tingkatan 3</i>
SA	Senior Assistant
S	Senior Secondary Education Student
SEAR-MT	Southeast Asia Regional Standards for Mathematics Teachers
SJKC	National-type Chinese Primary School
SPM	<i>Sijil Pelajaran Malaysia</i>
STPM	<i>Sijil Tinggi Persekolahan Malaysia</i>
T	Teacher
TEDS-M	Teacher Education and Development Study in Mathematics
UCSCAM	United Chinese School Committees Association of Malaysia

UEC	United Examination Certificate
UEC-JML/JUEC	UEC Junior Middle Level
UEC-SML/SUEC	UEC Senior Middle Level
UEC-V	Vocational Unified Examination

# **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 dalam 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

professional setting (Pantić & Wubbels, 2010). 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, Abudhuim, 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

Grade (%)	A (%)	B (%)	C (%)	D (%)	E (5)
CIHS Penang	9.7	18.44	23.3	39.8	8.73
National level	18.1	31.97	22.25	19.62	8.06

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. On 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 21<sup>st</sup> 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.

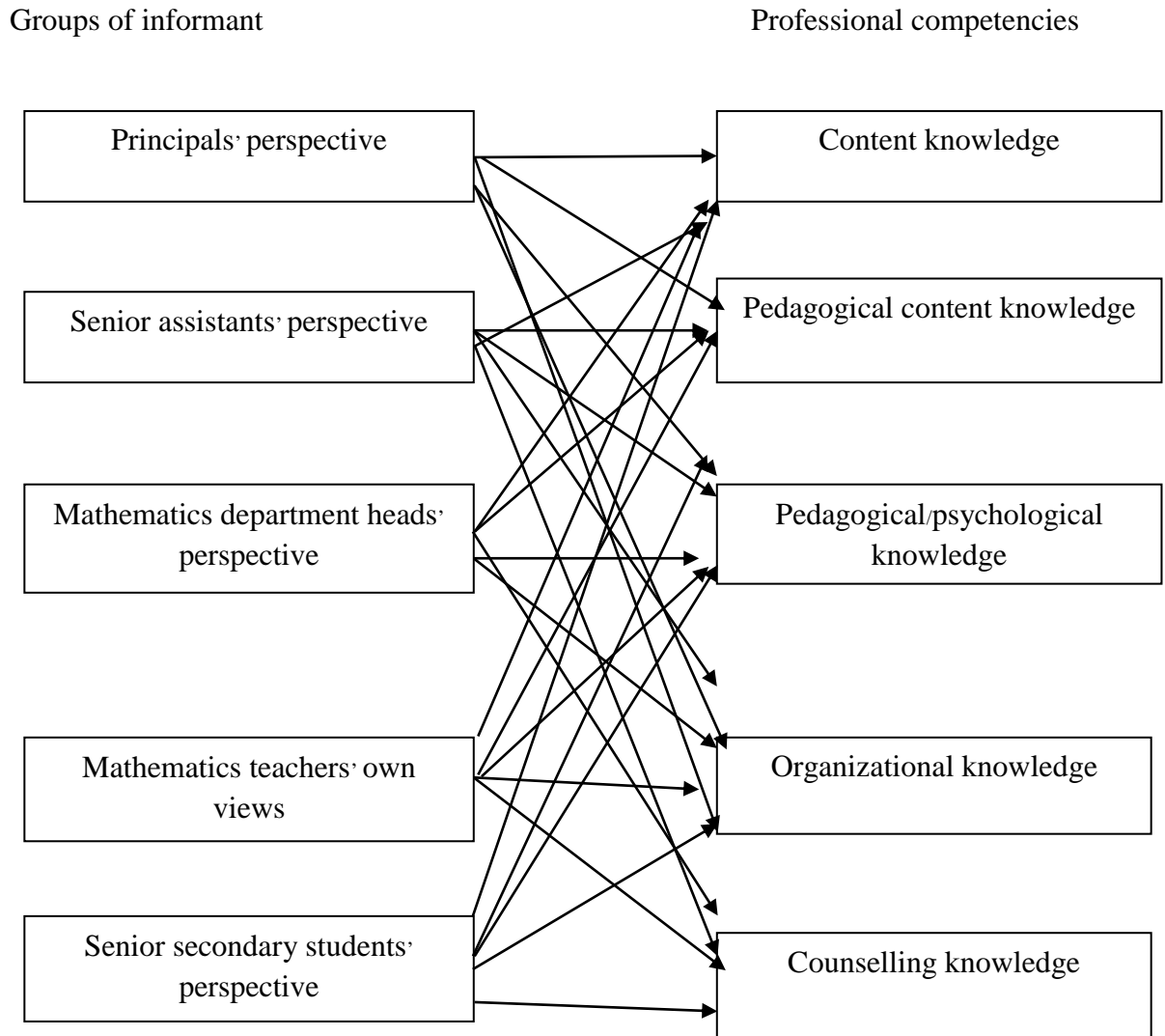
On the other hand, counselling knowledge is defined as a socially distributed and largely non-subject-specific form of knowledge that has to be bundled and interpreted for specific addresses in a given counselling situation. In detail, counselling knowledge in the COACTIV model is operationalized as 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.



**Figure 1.1 Research Framework**

## 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.