MULTIPLE INTELLIGENCES APPROACH TO INFUSE CRITICAL THINKING SKILLS AMONG PRESCHOOLERS

YONG SIEW NGET

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Field of Study: Early Childhood Education

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ABSTRACT

Critical thinking skills (CTS) are regarded as the imperative skills for the complex and rapidly changing twenty-first century. The national educational goal should focus on developing CTS during early years. However, the infusion of CTS is not evident in our national preschool curriculum. There are no explicit guidelines and instructional consensus for teaching CTS in preschool. Thus, this study aimed to explore the 'how' and 'what' for the teaching and development of CTS among preschoolers through the adoption of the Multiple Intelligences approach (MIA). In addition, this study also explored how the acquired CTS can be applied for solving problems by selected preschoolers. An exploratory case study approach was conducted among a class of twenty preschoolers (six-years-old), in a private preschool which has been adopting MIA for the past fifteen years. This study began with a feasibility study to gauge the readiness of young children towards critical thinking. A set of instructional support materials (ISM) with fifteen CTS infused MI based lessons which hinged on the framework established by a panel of ECCE experts was then designed for teaching CTS in the selected preschool classroom. Data collection was done basically through qualitative methods involving some quantitative data. Class observations on the implementation of all the fifteen lessons were conducted and audio-video recorded by the researcher. Semi-structured interviews with selected teachers and principal and focus-group interviews with selected preschoolers were also conducted. The qualitative data collected were analysed using the constant comparative method for an in-depth description on the development of CTS among selected preschoolers. Two instruments, the Preschool Critical Thinking Skills Tests (PSCTST: Pre-Assessment and Post-Assessment) were developed for assessing the CTS levels of children before and after the implementation of ISM. The quantitative data collected from the tests were analysed using simple descriptive statistics for this exploratory case study. The score results of the Post-PSCTST revealed a notable improvement in the CTS levels of selected preschoolers after the ISM implementation. Thus, ISM implementation was found to have enhanced the teaching and development of CTS through multiple modalities of learning. From this study, six themes were identified as contributive factors towards the CTS development: readiness, explicit teaching, scaffolding, routines, classroom climate and interplay of MI strengths. Selected preschoolers with similar strengths were found to work and think together more effectively in the same MI groups. Through the process of problem-solving tasks, selected preschoolers were found to have applied CTS systematically in relation to the cognitive aspects of interpretation of problem, analysis of information provided, making inferences of solutions and evaluating their choices before presenting the solutions. The essence of this study showed that preschoolers can learn and apply CTS in various contexts of problem-solving regardless of their dominant MI strengths. Hence, it can be concluded that a conducive thinking challenging environment (with MIA as the vehicle in this present study) is the essential medium for teaching CTS explicitly. Several implications and suggestions were put forward to various stakeholders and researchers.

PENYERAPAN KEMAHIRAN PEMIKIRAN KRITIS MENERUSI PENDEKATAN PELBAGAI KECERDASAN DALAM KALANGAN MURID-MURID PRA-SEKOLAH

ABSTRAK

Kemahiran pemikiran kritis (CTS) adalah kemahiran penting bagi abad ke-21 yang kian kompleks dan giat berubah. Matlamat pendidikan negara seharusnya bertumpu kepada perkembangan CTS terutama sekali pada peringkat pendidikan awal. Namun, penyerapan CTS tidak terangkum secara jelas dalam kurikulum prasekolah kebangsaan. Tambahan pula, tidak terdapatnya garis panduan dan konsensus penagajaran yang jelas untuk mengajar CTS di peringkat prasekolah. Oleh yang demikian, kajian ini bertujuan untuk meneroka 'bagaimana' dan 'apa' untuk mengajar dan menyerap CTS dalam kalangan kanak-kanak prasekolah melalui pendekatan kecerdasan pelbagai (MIA). Di samping itu, kajian ini juga bertujuan untuk meneroka bagaimana CTS yang diperolehi oleh kanak-kanak prasekolah itu digunakan untuk menyelesaikan masalah. Pendekatan kajian kes penerokaan ini dijalankan di dalam kalangan dua puluh orang kanak-kanak berumur enam tahun, terpilih daripada sebuah prasekolah swasta yang telah mengamalkan pendekatan MIA sejak lima belas tahun yang lalu. Kajian ini bermula dengan kajian kemungkinan untuk menentukan kesediaan anak-anak muda terhadap pemikiran kritis. Demi tujuan penyelidikan ini, disedaikan satu set bahan pembantu pengajaran (ISM) sebanyak lima-belas pelajaran yang berasakan pendekatan MI dengan CTS terserap dalam kurikulum yang sedia ada. ISM ini direka berdasarkan kerangka yang didirikan dengan panel pakar ECCE dan digunakan untuk mengajar CTS secara eksplisit di dalam kelas prasekolah yang terpilih. Pengumpulan data secara dasarnya dikutip menerusi kaedah kualitative dengan melibati sebahagian kecil data kuantitatif. Permerhatian dan rakaman video dilaksanakan bagi pengajaran kesemua lima-belas pelajaran tersebut. Wawancara

berbentuk separuh-struktur dengan pengetua, guru-guru dan wawancara kumpulan fokus untuk kanak-kanak prasekolah turut dijalankan. Data kualitatif pula dianalisis berdasarkan kaedah perbandingan induktif dan berterusan untuk membekalkan penerangan yang mendalam mengenai perkembangan CTS dalam kalangan kanak-kanak prasekolah. Dua instrumen untuk menguji tahap CTS kanak-kanak sebelum dan selepas pelaksanaan ISM {Preschool Critical Thinking Skills Test (PSCTST): Pre and Post} telah dibangunkan. Data-data daripada ujian ini dianalisakan dengan menggunakan statistik deskriptif mudah. Keputusan Post-PSCTST menunjukkan terdapatnya peningkatan tahap CTS yang ketara dalam kalangan kanak-kanak prasekolah setelah mengikuti pembelajaran ISM. Penemuan ini menunjukkan bahawa kanak-kanak prasekolah bermanfaat daripada pengajaran CTS yang eksplisit menerusi pendekatan pelbagai modaliti pembelajaran. Menerusi kajian ini, enam tema telah dikenalpasti sebagai faktor penyumbang terhadap pembangunan CTS: kesediaan, pengajaran eksplisit, perancah, rutin memikir, persekitaran kondusif dan interaksi kebolehan pelbagai kecerdasan (MI). Kanak-kanak prasekolah dengan kebolehan yang setara didapati bekerjasama dan berfikir bersama secara lebih berkesan dalam kumpulan MI yang sama. Menerusi tugas penyelesaian masalah, kanak-kanak prasekolah tersebut didapati menggunakan CTS secara sistematik berkait dengan aspek kognitif seperti mentafsirkan masalah, menganalisikan maklumat yang dibekalkan, menilai cadangan-cadangan yang dikemukakan serta membuat kesimpulan sebelum menyampaikan penyelesaian muktamat. Intipati kajian ini menunjukkan bahawa kanak-kanak prasekolah boleh membelajari kemahiran pemikiran kritis (CTS) dan menggunakan CTS untuk menyelesakan masalah dalam pelbagai konteks tanpa mengira kebolehan dominan MI mereka. Oleh itu, dapatlah disimpulkan bahawa pembekalan persekitaran yang mencabarkan pemikiran secara kondusif (di mana pendekatan MI adalah ‘kenderaan pengajaran’ di dalam kajian ini) merupakan media perantaraan penting untuk mengajar CTS secara eksplisit. Beberapa implikasi dan cadangan telah dikemukakan kepada pihak serta penyelidik-penyelidik berkenaan.

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LIST OF SYMBOLS AND ABBREVIATIONS

APA	:	America Philosophical Association
BK	:	Bodily-Kinesthetics
CTS	:	Critical Thinking Skills
DAP	:	Developmentally Appropriate Practices
ECE	:	Early Childhood Education
ECCE	:	Early Childhood Care and Education
INTER	:	Interpersonal
INTRA	:	Intrapersonal
ISM	:	Instructional Support Materials
K2	:	Kindergarten 2 (five to six-year-old)
LM	:	Logical-Mathematical
MI	:	Multiple Intelligences
MIA	:	Multiple Intelligences Approach
MOE	:	Ministry of Education
MR	:	Musical-Rhythmic
NE	:	Naturalistic-Environmentalist

NPSC	:	National Preschool Standard-Based Curriculum
OECD	:	Organisation for Economic Co-operation and Development
PISA	:	The Programme for International Students Assessment
PSCTST	:	Preschool Critical Thinking Skills Test
TIMSS	:	Trends in International Mathematics and Science Study
TK	:	Trinity Kids
VL	:	Verbal-Linguistic
VS	:	Visual-Spatial
ZPD	:	Zone of Proximal Development

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CHAPTER 1

INTRODUCTION OF STUDY

1.1 Introduction

Critical thinking skills (CTS) are reckoned as the imperative skills and competency required for the complex and rapidly-changing twenty-first century (Collier, Guenther & Veerman 2002; Lai, 2011; Melo, 2015) where the trend of success in life no longer depends solely on the proficiency of reading, writing and arithmetic as per required by the traditional society (American Management Report, 2012 cited in Halpern, 2014; Fisher, 2011). The future workforce is said to be greatly requiring "knowledge-workers" and "thinking-workers" who have the skills to analyse complex information, manipulate abstract ideas and to integrate logically with various knowledge which enable them to construct creative solutions and in making decisions to effectively solve those problems or challenges encountered in work and in life (Halpern, 2014; Lau & Chan, 2011; Salmon & Lucas, 2011).

Fisher, (2011) reiterates that CTS, in recent years, has become a "buzz word" in the educational realms with the rising demands for educators to "teach" thinking skills in schools, colleges and universities. However, realising that students of today's preschools will be the future "knowledge" and "thinking" workforce of tomorrow (Aubrey, Ghent & Kanira, 2012; Greenberg, 2014; Lim, 2011); the need to teach thinking skills should begin with the preschools. Moreover, studies revealed that young children can be taught to reason and think critically just like the way they are taught to read, write and count (Aubrey et al, 2012; Dewar, 2014; Padget, 2014).

In addition, scholars opined that training independent and competent thinkers with effective thinking skills should be the primary goal of learning and teaching in education right from early years (Wong & Yeo, 2014; Zahra, Yusoff & Hasim, 2012). Thus, the goal of today's education is suggested to centre on developing capable thinkers who will be the resourceful and competent human capital for the global resources and imperatives of the 21st Century (Greece, 2002; Halpern, 2014; Salmon & Lucas, 2011).

Furthermore, many research studies also assented to the fact that CTS can be promoted among children or taught to children and more effectively so, during their early years of growth and learning (Clarke, 2007; Davis-Seaver, 2000; Salmon & Lucas, 2011). In a few of her studies, Maria Birbili (2013) has pointed out that the opportunities for developing children's thinking skills are unlimited in early childhood education especially so with effective teaching strategies being employed. These opportunities for developing thinking skills are said to be present in the everyday learning activities engaged by children. As children participate in the learning activities, they learn to think through finding "answers" which address the questions they have in relation to the issues or situations they encounter (Fumoto, Robson, Greenfield, & Hargreaves, 2012, cited in Birbili, 2013). Thus, preschool is consented as an appropriate platform for helping young children develop their thinking skills through purposeful learning activities and appropriate teaching approaches (Birbili, 2013; Salmon & Lucas, 2011).

Just as cognitive skills, literacy skills and social skills are expected to be developed during the early years or preschool education, likewise CTS are suggested to be developed as early as possible with the assistance and support provided by the teachers (Salmon & Lucas, 2012; Wirawani Kamarulzaman & Ismail Sheikh Ahmad 2014). Wong and Yeo (2014) in their recent study, stressed that preschool education of Malaysia should be liable to incorporate strategies and develop appropriates practices of critical thinking in the classroom.

However, as noted in the preschool education guidelines of many countries like America, Britain, Greece and Sweden, there are no explicit guidelines or consensus provided for teachers to promote the development of CTS among the preschoolers (Aubrey et al, 2012; Birbili, 2013; Bjorklund, 2013; Salmon & Lucas, 2011). In the same notion, the current national preschool curriculum standard document of Malaysia being the official curriculum guide for the preschool teachers since 2010; there was no reflection of the explicit teaching of thinking skills as a requirement or mandatory element for preschool teaching and learning. This, in fact; has further curtailed the initiatives of preschool teachers to teach thinking skills to the children or help them develop the skills.

A few studies have further deliberated on the teaching and development of CTS with the Multiple Intelligences (MI) theory as the foundation for teaching or instructional strategy. The MI theory which is founded by Dr. Howard Gardner; in general, suggests that every individual possesses at least eight areas of intelligences namely: verbal-linguistic, logical-mathematical, visual-spatial, musical-rhythmic, intrapersonal, interpersonal, bodily-kinesthetic and naturalist-environmentalist which are vital to learning (Gardner, 1993). The Multiple Intelligences Approach (MIA) to teaching is said to provide unique opportunities that enhance the learning experiences and skills development of the learners as it addresses the different abilities and characteristics of each learner which in return further improve the skills developed and allow learners to achieve better learning outcome as well as to function better in the future world (Armstrong, 2009; Zobisch, Platine & Swanson, 2015).

Gardner contented that teachers need to know how children's minds or thinking are different one from another and help them use their minds or their thinking fruitfully (cited in Lee, Rio Sumarni & Nora, 2012). This implies that through MIA; teachers or educators will be able to help learners with different learning preferences in developing their thinking skills as the relationship of MI to CTS is grounded in a vision of addressing the different minds for developing the thinking skills through transformative teaching pedagogy or approach.

Lastly, the goal for developing CTS among young children should be reflected in their abilities to apply or transfer the CTS that they have acquired for purposeful reflection, reasoning and making meaningful decisions in new contexts or situations (Collins, 2014; Greece, 2002; Melo, 2015) as well as enabling them to be better life-long learners. When a six-year-old child while encountering an issue, is able to understand and analyse, organize some ideas or inferences, plan actions on how to counter-act or handle it; giving reasons for the choice of ideas or actions and decides on the selection of choices for solving that particular issue; he or she is said to have applied CTS (Facione, 1990; Nicoll, 1996; Wirawani Kamarulzaman & Ismail Sheikh, 2014).

Thus, this study opts to answer questions on how preschool children can develop CTS and whether appropriate teaching approaches or strategies in preschool education, particularly; the approach of Multiple Intelligences, when being employed; contributes to enhancing the development of CTS among preschool children during their preschool years of learning.

The next section sheds some light on the background of this study, explaining why the researcher opts to look at the development of critical thinking among preschoolers through the teaching approach or strategies based on the theory of multiple intelligences.

1.2 Background of Study

In countries such as United Kingdom, Northern Ireland, Canada, Finland and Singapore, the development of thinking skills has been included as one of the main foci of the educational goals for the early childhood education since 1990s, about two decades ago (Birbili, 2013; Greenberg, 2014; McGuiness, 1999; Ridley, 2000; Tay-Lim, 2011). The preschool curriculum guidelines and learning framework of these countries are placing greater emphasis on the development of critical thinking skills and problems solving skills besides nurturing communication, collaboration and creativity as vital capabilities which should be developed during the early years in order for children to be well-equipped for embracing the future challenges in life (Birbili, 2013; Greenberg, 2014; Taggart, Ridley, Rudd & Benefield, 2005).

Like many other Asian countries, the preschool education system in Malaysia is very much influenced by "examination results-driven" culture which reflects more of the rote-learning or memorization as well as the conventionally rigid ways of teaching. Teachers are under pressure to deliver "academic results" by focusing on teaching the basic literacy skills or knowledge memorization and thus shied away from teaching practical skills to young children, particularly; the critical thinking skills which are foundational to children's learning and development (Amalina Munirah Mohd. Zabidi & Nik Suryani Nik Abd. Rahman, 2012; Quinn, 1997). Amalina Munirah and Nik Suryani (2012) further concurred that teachers in Malaysia should move away from exam-oriented teaching and instead teaching children to think more critically.

Despite the growing awareness of the need to develop and nurture thinking skills during preschool education years; yet there is insufficient emphasis on thinking skills development in the National Preschool Curriculum Standard Document (NPCS, 2010) of Malaysia. The integration of CTS should be more evident in the Malaysian preschool teaching and learning.

Rohaty (2013), also highlighted in the study she conducted; that Malaysia needs to develop young thinkers and as such the national preschool curriculum should include the development of higher order thinking or CTS in order to prepare children who are able to reason and to solve problems.

There is also an increasing concern for improving CTS among the Malaysian students after their second participation in the recent 2012 PISA (Programme for International Student Assessment - an assessment that focuses on mathematics with reading, science and problems solving as minor areas of assessment for students of 15 years old). The PISA results showed that students from Malaysia fared rather lowly (ranking of 52 out of 65) in this international assessment (Scientific Malaysian, 2014). As reported in “THE STAR Online” dated 8 December 2013, the main reason for the poor-performance of Malaysian students in PISA 2012; was due to the incompetency of higher order thinking or critical thinking skills and as such, lacking the ability to solve real-life related problems.

As a result, the Malaysian 2015 Blueprint of Education consciously places greater emphasis on the development of higher order thinking skills (HOTS) for primary and secondary school education to ensure the improvement of thinking skills among Malaysian students and thereafter to be able to compete at the international arena (Business Circle, 2014). On the other hand, many researchers asserted that young children from four and a half years of age are able to display higher order thinking abilities and they are capable of understanding and thinking deeply, complexly or critically about the problems which occur around them as well as within their everyday social experiences (Davis-Seaver, 2000, Harms, 2013; Heyman, 2008; Pillow, 2008) and that they can be competent thinkers (Dahlberg, Moss & Pence, 1999).

Numerous leading experts in children's thinking skills development concurred that critical thinking skills (CTS) should be developed among the young children and one of the most effective stage is to teach these skills to the children during their early years of three to eight years old (Abrami et al, 2008; Birbili, 2013; Clarks, 2007; Davis-Seaver, 2000; Fisher, 2005; Robson, 2012; Salmon & Lucas, 2011). Fisher (2005) and Robson (2012), highlight that thinking is one of most fundamental human characteristics that a child engages in naturally and intentionally. Kuhn (1999), Birbili (2013) and Halpern (2014) pointed out that children are learning the skills of critical thinking when they receive and execute explicitly designed instructions from their teachers.

Following the increasing interest among educators to promote critical thinking skills development explicitly through more structured programme (Birbili 2013; Robson, 2012), many scholars and educators have supported the "thinking curriculum" or "infused curriculum" in order to promote the teaching and development of critical thinking skills, particularly among the school and college students (Audrey et. al, 2011; Fisher, 2011; Halpern, 2014; Nisbett, 1993; Padget, 2013), whereby thinking skills are taught in explicit ways across the curriculum. There are also other scholars such as McGuiness (1999), Davis-Seaver (2000), Robson (2012) and Dowling (2013) who proposed for infusing or integrating CTS into the everyday teaching and learning activities within the existing themes and topics which are of interest to young children

(Birbili, 2013; Davis-Seaver, 2000; Dowling, 2013; Taggart et al, 2005; Robson et al, 2012) to explicitly teach the skills of critical thinking.

Currently, there is yet an ideal pedagogy or approach available on how to teach or develop thinking skills provided for schools or preschools. However, in order to complement the development of CTS among these young learners; it is essential for educators to look at the possibility of exploring some kinds of explicit instructions, learning activities or study on the appropriate teaching approaches that can be employed in order to facilitate the development and teaching of CTS among the young children during their preschool education.

However, some studies revealed that MI theory is recognized as an effective framework for teaching. The teaching approach based on MI theory is said to be able to offer a wider range of opportunities for different type of learners to learn from different notions of learning activities in accordance to their strengths (Noble, 2004; Zobisch et.al. 2015). For example, learners who are gifted in visual spatial intelligence will learn more effectively through activities involving visuals, illustrations, graphics and symbols. They are able to understand metaphors better and may most likely use mind-mapping or symbols more effectively for problem solving (Armstrong, 2009; Noble, 2005). Thus, it further implies that MI Theory can be employed as an approach to teach critical thinking and help young children develop the skills of thinking critically through the various learning activities which appeal to their respective strengths or learning preferences.

Therefore, for the purpose of this study, the multiple intelligences teaching strategies or approach which is based on Howard Gardner's MI Theory founded in 1983 will be used as one of the main references in the perspectives of its contribution and impact on the teaching and development of CTS among the preschoolers.

One preschool of an established group of private preschools known as Trinity Kids in the city of Malaysia was particularly selected to provide the background for this study as it has adopted MI Theory for its preschool curriculum development as well as the day-to-day teaching and learning strategies conducted specifically through multi-faceted MI activities with English Language as the main medium of instruction for the past fifteen years.

In addition, as mandatory for all preschools in Malaysia, Trinity Kids' curriculum is in compliance with the national preschool curriculum guidelines. The next section provides further elaboration on the national preschool curriculum guidelines.

1.2.1 National Preschool Standard-Based Curriculum (NPSC) of Malaysia

Through the National Education Act of 1996 (Act 550), preschool education (both public and private) was officially recognized as part of the school system under the Ministry of Education (Malaysia National Education for All, 2015). Under this Act, all preschools in Malaysia are required to adhere to the national preschool curriculum guidelines and quality standard set by Ministry of Education.

The first National Preschool Curriculum (NPC) was implemented in 2003 and was later upgraded in 2010; known as the National Preschool Curriculum Standard (NPCS) Document. In 2017, there was another review on the curriculum document. The latest reviewed or upgraded version of NPCS; is now known as the National Preschool Standard-Based Curriculum (NPSC). The NPSC was officially implemented effective 1st January 2017 across all the public and private preschools or kindergartens in Malaysia.

Overall, the latest version of NPSC (2017) has been simplified and made flexible for easier planning and implementation of teaching and learning processes but giving greater emphasis on higher order of thinking while maintaining its focus on the six strands or domains of development: (1) communication; (2) spiritual, attitude and values; (3) science and technology; (4) humanity; (5) physical and aesthetic; (6) personal competent and socio-emotional which aims to develop students who are competent to think and communicate.

The preschool education in Malaysia also aims to ensure holistic development of each child's potential through providing enriching environment as well as meaningful learning activities which are child-centred and developmentally appropriate for young children of different learning abilities. The inclusion of the standard preschool assessment instrument serves to assess and monitor the progress of each child in accordance to the six strands of development periodically.

Application of developmentally appropriate practices (DAP) in the teaching and learning processes of preschool education is the ultimate goal of NPSC 2017 in cognizance with the policies of NAEYC, the National Association for the Education of Young Children of United States (Jain Chee, Mariani Md. Nor, Abdul Jalil Othman & Mashitah M.R. Nor, 2017); whereby preschool teachers are required to be knowledgeable about young children's age-related and domains of development as well as their cultural context in order for them to plan appropriate teaching strategies to promote each individual child's potential, development and learning (NAEYC, 2009). NAEYC (2009) also posits that preschool teachers' sensitivity and responsiveness in implementing the day-to-day lessons and their moments of interaction with the children are said to provide the greatest impact on children's full spectrum of development, learning and thinking.

Critical and creative thinking abilities as well as innovativeness are well recognized as important contributing elements in developing the holistic individuals in the NPSC 2017 (refer to diagram 1: Framework of NPSC, 2017). The upgraded NPSC is in cognizance with the educational goals of Malaysia Blueprint of Education 2013 - 2025 to equip the students today with higher order thinking skills, the 21st century skills (Ministry of Education, 2013).

As such, NPSC 2017 places great emphasis on developing young holistic learners who are able to think creatively and critically as well as having the confident in taking up challenges, creating appropriate products or solutions, solving problems and are ready for life-long learning.

However, the Standard-Based Curriculum and Assessment Document revised in 2017 has yet to provide any specific guidelines on the teaching of creative and critical thinking skills for the preschool teachers although it encourages the inclusion of teaching thinking skills in the day-to-day curricular teaching in a very general manner.

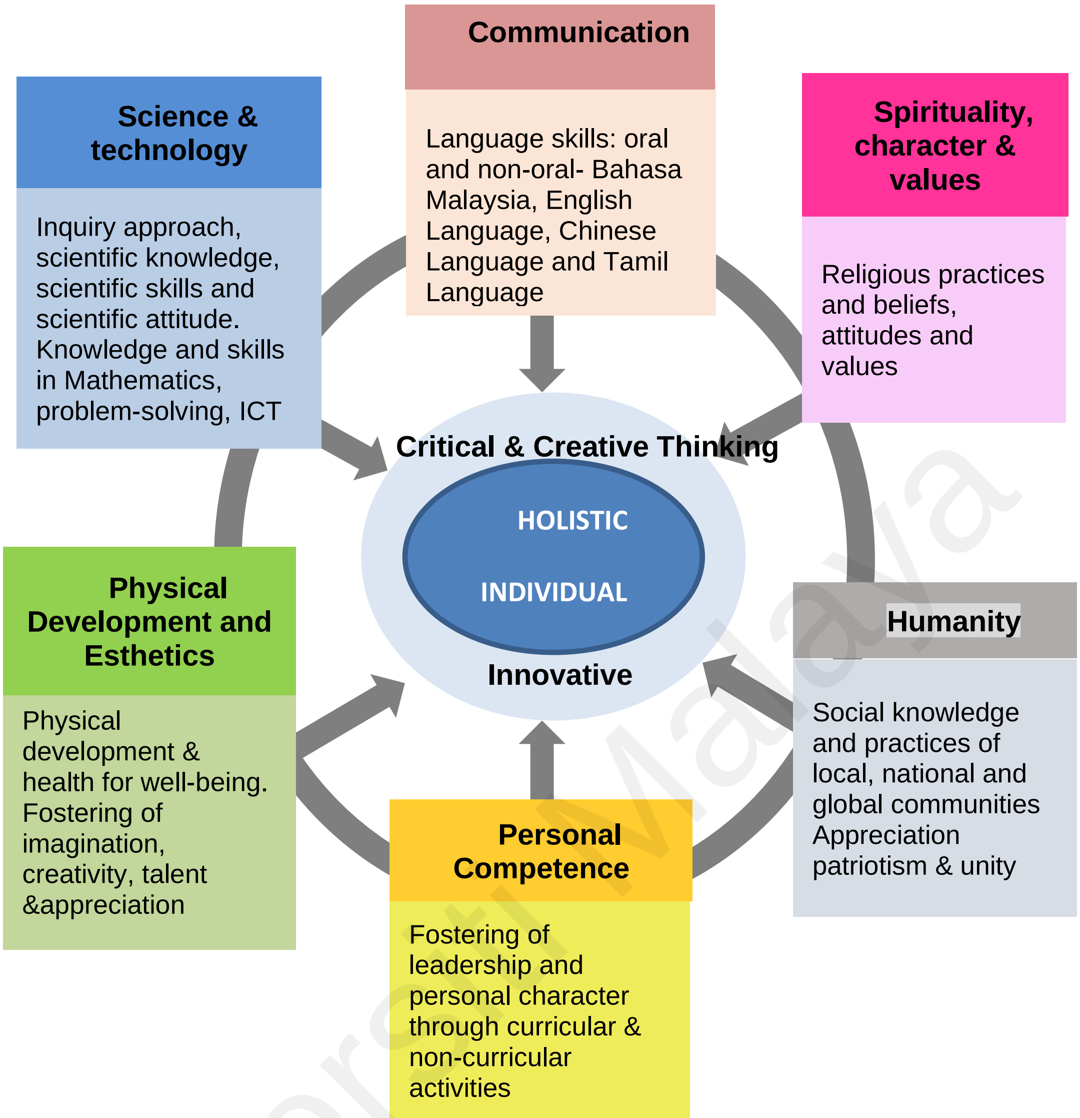


Figure 1.1 Curriculum Framework of National Preschool Standard-based Curriculum (NPSC), 2017

1.3 Problem Statement

Generally, students in schools are required to learn basic literacy skills such as language literacy (reading and writing) and numeracy (counting); memorise information provided; analyse data before making decisions or solving problems but without being taught the "how to" (Halpern, 2014). In contrast, Michael Scriven has argued that critical thinking skills should be acknowledged as the "competency" or skills which are of equal importance to literacy skills and thus, should be taught and learnt by the students in schools (cited in Fisher, 2011).

Beyond equipping students with the basic skills, Paul (1995) accentuates that critical thinking should be the center of education whereby students should ideally learn to think critically as a result of their 'schooling' instead of just memorising sets of facts or to prepare a prescribed sets of answers for tests and examinations (Davis-Seaver, 2000).

According to the report of the Programme for International Student Assessment (PISA) result for 2012; the performance of Malaysian students was found to be below the average score set by OECD (Organisation for Economic Co-operation and Development), the publisher of PISA. As per reported by Kang in 'Star Online' (2013), Malaysia ranked 52 out of 65 countries with its students faired lowly particularly so, in the assessment of mathematics with problem solving as the minor assessment (Scientific Malaysian Magazine, 2014). The deficient performance reflected that Malaysian students lack the ability to think critically over real-life issues or challenges and therefore they are not able to apply thinking skills effectively for problem solving (Azian T. S. Abdullah, Muhammad Zaini Mohd Zain, Sheela G. Nair, Rusliza Abdullah & Ihsan Ismail, 2016; Kang, 2013; Zul Fikri Zamir & Anas Alam Fazli, 2013).

This has further escalated the concern of the Malaysia Education Ministry for the need to ensure students acquire CTS for problems solving long before they reach secondary school education, which implies that these skills should be taught or developed much earlier such as during the preschool education stage (Azian et al., 2016; Sharifah Norul Akmar Syed Zamri & Ihsan Ismail, 2014).

Studies showed that it is far more effective for these skills to be developed during the early years of the young children (Taggart et al, 2005; Clarke, 2007). On the same account, thinking experts like Kuhn (1999). Birbili (2013), Fisher, (2005) and Dowling (2013) also strongly advocate that critical thinking skills development should be one of the main foci of all teaching and learning processes for young children in order to equip them as thinkers who, in return they can become successful learners, aptly equipped for the social and professional demands of the 21st century (Clarke, 2007; Davis-Seaver, 2000; Gwen, 2012; Halpern, 2014; Paul. 1995).

Prominent advocators of thinking skills for young children such as Dean Kuhn (1999), Carol McGuiness (1999), Jean Davis-Seaver (2000), Sue Robson (2012), Marion Dowling (2013) and Diane Halpern (2016) stressed that the development of thinking skills is a process that needs to start off from the early years but often times, the early childhood curricula do not include the teaching of thinking skills as a mandatory element in their official document (Birbili, 2013).

Kuhn (1999), also highlighted a pertinent point in her study, stating that preschool teachers have been so used to the conventional teaching which is academic-bias, would require more support and assistance for them to envision and embrace the teaching of thinking skills as one of the preschool educational goals.

In the context of preschools, young children will learn to think critically when they are given the opportunities and reasons to think in critical ways, when they see others engaged in critical thinking, when they are admitted into real-life scenarios such as arguments, challenges, debates and decision makings or when they are taught to think critically through the daily activities and the encounter of events in their everyday living experiences (Smith, 1986, p. 107, cited in Davis-Seaver, 2000). As such, there is a need to reinforce the development of children's thinking in the preschool curriculum in fulfilment of their cognitive needs to resolve conflicts or solve daily problems encountered (Wong & Yeo, 2014).

Malaysian early childhood educators are, in general receptive towards endorsing the perspective of developing thinking skills as essential life skills besides the acquisition of basic literacy among preschoolers as this was discussed during the last exercise of curriculum-review in February 2016 in preparation for the upgrading of the National Preschool Standard-Based Curriculum (NPSC) which was implemented since 2010. It was consented that, just like cognitive skills and literacy skills; thinking skills development cannot be left to happen by chance but instead should be distinctively promoted and taught implicitly or more so explicitly during preschool education assisted by the teachers (Padget, 2013; Wirawani Kamarulzaman & Ismail Sheikh Ahmad, 2014).

Despite the growing awareness of the need to develop and nurture thinking skills during the early years, yet the emphasis on the development of thinking skills seems lacking in the landscape of Malaysia preschool education (Rohaty Mohd Majzub, 2013). The NPSC, being the main curriculum guide for the Malaysian preschools; has not reflected explicitly the guidelines for the preschool teachers to promote and teach critical thinking skills in the preschool classrooms.

Also, it has yet to identify an ideal pedagogy or teaching approach for teaching CTS thus far. While there is no consensus on how to teach or develop critical thinking skills among young learners in the preschools settings (Audrey, Ghent & Kanira, 2012; Bjorklund, 2014), numerous studies proposed that CTS can be taught and developed through infused curriculum, that is through integrating or infusing these skills into the daily teaching-learning activities within the curriculum with the support of appropriate teaching approaches or strategies (Birbili, 2013; Davis-Seaver, 2000; Dowling, 2013; Halpern, 1998; Swartz & Parks, 1994; Taggart et al, 2005).

However, the infusion of CTS is NOT evident in the preschool teaching and learning of Malaysian landscapes (Wirawani Kamarulzaman & Ismail Sheik Ahmad, 2014) although the revised National Preschool Standard-Based Curriculum document (NPSC or KSPK in Malaysia's national language) does include the development of critical and creative thinking skills amongst the important objectives of learning in complimenting the six strands of development. Malaysia's preschool education still inclines to focus more on excelling in academic achievements (Lily Muliana Mustafa & Mohamed Nor Azhari Azman, 2013).

Besides, teachers do need explicit guidelines and instructional materials support for them to teach CTS in the preschool classrooms. Students can learn to think more critically when they receive explicit instruction which is designed specifically for this purpose (Birbili, 2013; Ennis, 1997; Halpern, 2014. p. 17). McGuiness, Eakin, Curry and Sheehy (2007) also concur in encouraging all teachers to set out teaching children the different forms of thinking more explicitly to help them learn and develop thinking skills in the classroom.

On the other hand, numerous researches in the past showed that employing the Multiple Intelligences approach to teaching which supports the notion of various different learning preferences show that the approach yields effective learning outcomes and helps to enhance skills development among young learners or children (Bellanca, 1997). This approach is said to provide a broad platform for allowing a wide range of teaching strategies and learning activities which aim to address the different learning preferences of the learners to be implemented in the classrooms (Armstrong, 2009; Bellanca, 1997; Zobish, Platine & Swanson, 2015).

The researcher of this present study attempts to explore on establishing an appropriate approach for teaching CTS and promoting the development of CTS among the Malaysian preschoolers. To accomplish the purpose of this study, the employment of infusion approach for the core skills of critical thinking to be integrated into the existing preschool curriculum or learning activities and the Multiple Intelligences Approach (MIA) to teaching, are the main foci of discussion in this study.

1.4 Objectives of the Study

This study aimed to explore how CTS can be taught and developed among preschoolers, the teaching strategies involved, and the instructional support required as well as how the acquired CTS can be applied for problem solving. This study looked at two aspects: the teaching of CTS through infusing CTS into the daily lessons through adopting MIA for the teaching and the exploration of the development critical thinking skills in the preschool classroom.

The specific objectives of this study are:

1. To prepare the framework of MI based CTS infused lessons {as the instructional support materials (ISM)} for implementation among the selected six-year-old preschoolers of Trinity Kids
2. To determine the level of CTS among the selected preschoolers of Trinity Kids: before and after the implementation of ISM.
3. To describe the development of CTS among the selected six-year-old preschoolers of Trinity Kids; and
4. To explore how the CTS acquired can be applied for problem solving among the selected six-year-old preschoolers of Trinity Kids.

1.5 Research Questions

Based on the research objectives stated above, the researcher of this study has drawn up the following research questions:

1. What is the framework of the MI based CTS infused lessons {as the instructional support materials (ISM)} for implementation among the selected six-year-old preschoolers of Trinity Kids?
2. What is the level of CTS among the selected six-year-old preschoolers of Trinity Kids before and after the implementation of ISM?
3. How is the development of CTS among selected six-year-old preschoolers of Trinity Kids?
4. How is the CTS acquired among the selected six-year-old preschoolers of Trinity Kids applied for problem solving?

1.6 Rationale of the Study

Developing CTS in young children can be a precursor to later achievement (Dowling, 2013) where children learn to think for themselves from young (Fisher,2005) and it lays the foundation as a life-tool for young children to be confident learners as well as becoming the thinking and competent problem-solving human capital of the 21st century (Halpern, 2014; Paul, 1995).

Furthermore, numerous thinking experts claimed that individuals who have acquired critical thinking skills are found to be able to render more accurate judgements as well as to offer more effective solutions for the problems encountered in real world (Fisher, 2011; Greenberg, 2014; Halpern, 2014). As such, in order to be able to function successfully in the 21st century, students need to acquire critical thinking skills (Bellanca, 2014; Dewar, 2014; Greenberg, 2014).

Besides, Melo (2015) emphasizes that the skill of thinking critically is a life-long process which should be acquired during the early years of children's development as it has direct relation to the structuring of cognitive configuration in understanding the world around them and their life experiences. This, leads to the implication that CTS are as essential as the basic literacy skills such as reading, writing and counting which should be learnt and developed from young.

Based on the above premises, the researcher recognized the needs of teaching and developing CTS explicitly among the preschoolers and that there's a need to infuse CTS into the preschool curriculum or teaching and learning activities in order to support the teaching and development of CTS in the preschool classrooms (Birbili, 2013; Dowling, 2013) as the guidelines or support for teaching CTS are lacking in the Malaysian preschool settings.

The researcher of this study has been involved with preschool education for the past twenty-five years. As a pioneering member responsible for setting up the group of (thirty-four) established prototype preschools known as Trinity Kids in peninsular Malaysia since 1992, the researcher was also instrumental in incorporating MI into the preschool curriculum for the group. The researcher is also responsible for training the Trinity Kids teachers in employing MI approach for the delivery of the day-to-day lessons in their classrooms.

Over the past fifteen years of implementing MI based curriculum in this group of preschool centres, the researcher observed that Trinity Kids preschoolers have benefitted from the MI teaching and learning approach in terms of achieving better learning outcomes and skills development. In general, it was also noticed that children enjoy the learning processes and they are found to be able to acquire literacy skills far more effectively as delivery of lessons was conducted using a variety of MI activities with the aim to address the different learning preferences or strengths of the young children. Therefore, the researcher intends to investigate if MI theory as the teaching approach which has been widely adopted by Trinity Kids teachers over the years does contribute to the development of CTS as well among their preschoolers.

Furthermore, the literature review conducted by Taggart et al (2005), revealed that infusion approach was generally better received by educators for the teaching of thinking skills among children of early years as compared to other approaches. The infusion approach allows the core skills of thinking to be infused into the existing curriculum by restructuring the teaching materials or by adding of relevant activities within a wide range of subjects which encourage reasoning, judgement and problem solving (Bellanca, 2014; Dowling 2013; Lin, 2014; Swartz, Fischer & Parks, 1989).

To accomplish the purpose of this study, the approach of infusing (Park & Swartz, 1994) CTS into the daily learning activities of the existing MI based curriculum of a selected preschool classroom and the use of teaching or instructional strategy or approach based on the theory of Multiple Intelligences (Armstrong, 2009) or also known as Multiple Intelligences Approach (MIA) in this study, will be the main foci of this study.

It is also known that teachers do need explicit guidelines and instructional support materials (as teacher's tools) or learning activities designed for teaching the skills of critical thinking among preschoolers. Studies shown that students can learn to think more critically when they receive explicit instruction that is specifically designed for teaching thinking skills (Ennis, 1997; Halpern, 2014. p. 17; Padget, 2013). McGuiness, Eakin, Curry & Sheehy (2007) also encouraged teachers to set out to teach children the different forms of thinking skills more explicitly to help them learn and develop thinking skills in the classroom.

For the purpose of supporting teachers in teaching the critical thinking skills, a set of MI based learning activities infused with the four core CTS (the four core critical thinking skills from Facione's Delphi definition namely; 'interpretation', 'analysis', 'inference' and 'evaluation' which were identified as developmentally appropriate for preschoolers) will be prepared as the instructional support materials (ISM) for the teachers to teach CTS to preschoolers particularly at one selected Trinity Kids preschool. Further justification for adopting four out of six core CTS will be explained in the methodology chapter.

For this case study in particularly; one Trinity Kids preschool centre and a class of six years old will be selected as the sample site to explore how MIA enable the teachers of this Trinity Kids preschool centre help their preschoolers of six years old develop CTS through the implementation of CTS infused lessons through MI learning activities in the preschool classrooms.

1.7 Significance of the Study

Critical thinking applications to education and curriculum are more commonly found in middle and high school settings in many other countries, they are seldom included in the primary schools (Ennis, 1994; Paul, 1995). In fact, thinking curriculum is rarely adopted in preschool (Davis-Seaver, 2000; Wirawani binti Kamarulzaman & Ismail Sheikh bin Ahmad, 2014). Similarly, there have been many studies conducted on the development of critical thinking in relation to the older students of middle or secondary schools, high schools, colleges and universities but there is little evidence of research studies being conducted in the preschool settings (Melo, 2015) especially so, in Malaysia (Norsiah Fauzan & Norfarahin Mat Zaini, 2015; Wirawani binti Kamarulzaman & Ismail Sheikh bin Ahmad, 2014).

Therefore, in line with the educational goals of Malaysia which begin to place greater emphasis on promoting higher order thinking skills among the students as evident in the Education Blueprint 2013-2025; this present study serves a few significances. Firstly, this study echoes the notion that CTS should be included in the preschool classrooms in order to make critical thinking a life-long tool of inquiry and for managing challenges or issues in life since young children are found to be capable of thinking in depth as early as at the age of three or four (Pillow, 2008; Davis-Seaver, Smith, & Leflore, 2001), this study takes an initial step to explore how CTS can be developed among young children in the preschool classrooms.

The researcher is contextualizing the development of CTS in the context of preschool education as studies proposed that critical thinking is best to be promoted in the early childhood classroom during the early years of growth and development for children aged four to six (Davis-Seaver, 2000; Dowling, 2013; Quinn, 1997). Finding of this study can further enhance the literature in suggesting that preschoolers can develop CTS when given the platform to do so and supported by appropriate teaching approach and strategy.

Secondly, this present study aimed to create greater awareness among preschool teachers and policy makers on the need to teach and help preschoolers develop the skills of critical thinking in the preschool classrooms through the use of thinking curriculum and diverse instructions by creating a variety of learning activities that motivate children of different strengths or learning preferences to participate and construct their own thinking (Carreiro, 1998; Gardner, 1993; Noble, 2004; Zobisch, Platine & Swanson, 2015). Children need to be taught explicitly on how to think critically through a purposeful structure of the curriculum and there is also a need for appropriate instructional strategy or approach to be employed by teachers to facilitate the critical thinking development processes (Davis-Seaver, 2000; McGuiness, 1999).

In view of the fact that there is no consensus on how to best teach thinking skills or critical thinking to young children (Audrey et.al, 2012), this case study opted to explore on the possibility of using "infused pedagogy or approach" to enable the core cognitive skills of CTS (based on APA Delphi Report) be taught explicitly across curriculum or learning activities (Aubrey et al, 2012) and the findings of this study should reflect the applicability of infusing critical thinking into the preschool curriculum of Malaysia as well as its positive impact in the teaching and development of thinking skills among children during their early years of education.

Thirdly, in the context whereby the teaching of thinking skills is yet to be made mandatory for them, preschool teachers are vulnerable and uncertain about teaching these skills in their classrooms (Audrey et al, 2012; Birbili 2012). Moreover, these teachers do need some forms of reference or models on how to teach CTS to young children in their classrooms, such as; how CTS can be integrated into their everyday teaching activities in order for them to promote a positive acquisition of the CTS among children and to see these skills been applied in other context (Dowling 2013; McGuiness, 1999). Thus, there's a need to provide instructional support material (ISM) as teaching aids for teachers to teach and help develop CTS among preschoolers in the preschool setting.

Based on the above purpose, the researcher prepared a set of complementary learning activities which are infused with the four core skills of APA Delphi consensual definition of CTS (namely: "interpreting", "analysing", "inferring" and "evaluation") as the instructional support for teachers to promote critical thinking skills in their preschool classrooms. The set of complementary instructional support materials (ISM) are specifically the existing lessons of English, Mathematics and Science being infused with the four core cognitive skills of critical thinking. These lessons were implemented through various MI based activities with every activity reflecting a few areas of intelligences to meet the respective learning preferences of different learners.

Apart from being used as instructional support material for the preschool teachers to teach CTS; this set of complementary activities can also be shared as a form of resource with the future researchers to enhance teachers' pedagogical knowledge in teaching CTS to young children.

Fourthly, for the purpose of identifying an appropriate or positive teaching approach that can be employed for teaching and enhancing the development of critical thinking skills among preschoolers, there is a need to look at some relevant approaches and teaching pedagogical choices (Birbili, 2012; Taggart el at, 2005). This study has a significant implication for the preschool educators in the perspective of exploring the contribution of MI Theory as a teaching approach or strategy (Armstrong, 2009) in the preschool classrooms. The finding of this study may further support the fact that MI related teaching concepts can generally help students be motivated towards effective learning which is expected to yield better outcomes in skills development among learners (Wilson, 1998; Zobisch et al, 2015).

Lastly, this present study serves as an empirical evident that CTS can be taught to and developed among preschoolers during their early years of growth and development. Many preschool teachers failed to reckon that young children are capable of thinking critically as in they are able to interpret and analyse issues encountered, reason on the assumptions, make inferences and draw conclusions before making decision on the choice of solution for solving that particular issue (Halpern, 2014; Padget, 2013). The empirical evidence of this study may help Malaysian preschool teachers to pay more attention to the teaching of CTS to young children instead of overly focusing on the teaching of literacy skills.

In conclusion, this study can be instrumental in articulating the urgency for the policy makers and educators of Malaysian preschool education to include the guidelines on development and teaching of CTS explicitly into the national preschool curriculum as a means for the teachers to help young children develop these essential skills during their early years of development. Importantly, there is greater awareness among policy makers and stakeholders of the need to provide instructional support for teachers to facilitate the teaching of CTS and to enable the development of such skills among children.

1.8 Definition of Terms

Critical thinking skills (CTS): refers to the abilities of reflective, in-depth thinking and active interpretation process of thoughts (Fisher, 2011; Fisher & Scriven, 1997; Scriven & Paul, 1996) which has often been related to higher order thinking and the application of the abilities for problems solving (Collins, 2014; Halpern, 2014; Melo, 2015). The APA Delphi consensus definition of CTS provided by Facione (1990; 2015) and his team of forty-six thinking experts describe critical thinking as a purposeful and reflective process of thoughts involving the core cognitive skills of interpretation, analysis, inference, evaluation, explanation and self-regulation. In the context of this study, only four out of the six core skills (interpreting, analysing, inferring and evaluating) which are identified as developmentally appropriate for preschoolers will be investigated (Insight Assessment, 2017; Nicoll, 1996).

Infusion approach: refers to the inclusion or integration of specific thinking skills into the existing content of teaching across the curriculum subjects (Swartz & Parks, 1994) in well-planned or well-strategized ways in order for those skills to be taught in an explicit and direct manner to learners though the delivery of lessons (Ennis, 1997 as cited in Padget, 2014). In the context of this study, the four selected "CTS" (interpretation, analysis, inference and evaluation) was purposefully infused into the existing preschool curriculum and learning activities for the six years old in the form of the instructional support materials (ISM) for the teacher.

Preschoolers: refers to young children between the ages of four to six who are undergoing the early childhood programme or preschools education (preceding to elementary education or primary school education) in the landscape of Malaysian education (Lily Muliana Mustafa & Mohamed Nor Azhari Azman, 2013). In the context of this study, the preschoolers are the six-year-old students from one preschool class of one selected Trinity Kids Preschools.

Multiple Intelligences Approach (MIA) to teaching: refers to an instructional technique or teaching pedagogy based on MI theory, designed to support the notion of eight intelligences or learning preferences or proclivities (Weber, 2005; Zobisch et al, 2015), namely: verbal-linguistic, logical-mathematical, visual-spatial, musical-rhythmic, bodily-kinesthetic, naturalist-environmentalist, intrapersonal and interpersonal (Gardner, 1993; Smith, 2008). MIA is an approach whereby teaching and learning is done through a variety of activities which are directed at addressing different learning preferences of learners (Armstrong, 2009; Gardner, 1993). In the context of this study, MIA is the teaching instructional approach employed for implementing the CTS infused lessons (or the ISM) whereby the delivery of every lesson is supported by three to four learning activities which encompassed all the eight areas of MI.

Problem Solving: refers to the systematic procedures or operations directed at looking for a solution or answer to solve an issue or a problem through thinking critically and making effective decisions (Synder & Synder, 2008; Uus Toharudin, 2017). In the context of this study, problems solving is the process in which children are challenged with three thinking tasks on problems specifically designed which required them to understand and interpret information provided before analysing them and inferring possible ways to solve them more effectively through making better decisions or taking better course of actions.

Instructional Support Materials (ISM): refers to a set of resources for teaching which may make up of discipline-specific lessons which directly or indirectly used to support or scaffold the teaching or learning of a particular skill such as critical thinking (Bowers, 2006; Mcneill, Lizotte, Krajcik & Marx, 2006). In the context of this study, ISM is a set of supplementary teaching activities prepared by the researcher for teachers to implement in the selected preschool classroom. This ISM comprises 15 lessons (60 minutes each) with ***four core skills of critical thinking*** (namely: interpretation, analysis, inference, evaluation) being infused into the existing lessons of three subjects: English, Mathematics and Science for the six-year-old preschoolers of Trinity Kids.

Infused: refers to the inclusion or incorporation of something such as values, elements or skills into an existing status or material. In the context of this study, four core-cognitive skills of CTS were infused into the existing curriculum for the purpose of teaching and learning of CTS (Swartz & Parks, 1994).

1.9 Scope of the Study

This study explored the teaching and development of several core cognitive skills of critical thinking among the selected six-year-old preschoolers of a Trinity Kids Preschool. CTS is known to be a pervasive term with a wide scope of definitions by numerous well-known thinking experts such as Robert Ennis, Richard Paul, Linda Elder, Diane Halpern, Micheal Scriven, Benjamin Bloom, Robert Fisher, Jean Davis Seaver and Peter Facione (Facione, 2015; Padget, 2013; Petress, 2004).

This study employed the definition of critical thinking skills (CTS) through the lens of Facione's statement of expert consensus on critical thinking. This present study did not cover all the dimensions of critical thinking as stated in the executive summary of the Delphi Report by Peter Facione as not all the six skills are developmentally appropriate for preschoolers (Facione, 2015; Nicoll, 1996). The researcher focused only on the teaching and development of only four (out of the six) core cognitive skills of critical thinking such as interpretation, analysis, inference and evaluation. This study also did not cover the disposition dimension of critical thinking.

The teaching and development of core cognitive skills of critical thinking will be implemented through the delivery of the fifteen infused lessons (sixty minutes each) or ISM (instructional support materials) in the selected preschool classroom. Further discussions on ISM and documentation for the observations of the ISM or lessons implementation will be explained in Chapter 4: Methodology.

Importantly, this study hinges on the teaching approach which is basing upon the theory of Multiple Intelligences founded by Howard Gardner (1983, 1993) which posits that there are eight areas of intelligences (namely: verbal-linguistic, logical-mathematical, visual-spatial, musical-rhythmic, naturalist-environmentalist, interpersonal and intrapersonal) which are vital to learning as the learning strengths

(Armstrong, 2009; Gardner, 1993). The Multiple Intelligences approach to teaching is said to be an effective instructional technique as it is designed to support the notion of eight different strengths or learning proclivities of the learners (Zobisch et al., 2015). This implies that the teaching activities for each lesson need to be carefully planned to address the preschoolers' learning proclivities which are in correspondence to their MI strengths.

1.10 Limitation of the Study

Although this present study intends to explore how CTS can be developed among the preschoolers who are often referred to children aged four to six in this country, however; the selected sample was confined to six-year-old preschoolers. As such, the findings of this study may not be able to reflect the CTS development of younger children such as those aged four and five.

Besides, due to the nature of this study, the exploration of children's CTS development was conducted through a selected class of six-year-old from a well-established private preschool centre in the city of Malaysia. This group of selected preschoolers were deemed to be 'more-ready' or 'suitable' for this study as it is conducted in English (their second language). Therefore, the finding of this research study might not generalize the development of preschoolers from the public preschools or those from other regions in this country as a whole.

In addition, this study was intentionally aimed to explore the CTS development within a specific context of as class of preschoolers in Trinity Kids preschool centre. Thus, the researcher did not intend to generalize the findings of this study. Nevertheless, this study will certainly serve as a guide and support for teachers to teach CTS as an empirical basis as discussed in section 1.6.

Also, it is worth mentioning that for the purpose of this study, the result of PISA 2012 ranking list released by OECD was used as the main reference for this study. The researcher has no intention to make any official reference to the data of the PISA results for Malaysia 2015 due to the fact that it was an internal assessment result provided by the ministry as a form of comparison with the results of previous years- 2009 and 2012 (Ong, 2016). The Malaysia 2015 PISA results were deemed not to have met the full criteria set by OECD and thus were not officially featured in the actual OECD PISA 2015 result rankings list. Therefore, the researcher would only make reference to the official PISA results of 2012 released by OECD as the official reference for this study.

As the researcher is a part of the institution under study, biasness may therefore arise. As such, this study has actively incorporated several strategies to ensure minimizing possible biasness of investigation and to enhance the substantiality of the interpretation of findings such as employing internal and external validity, members' check and peers' review which will be further discussed in Chapter 4, Section 4.9.

Also, this study is an exploratory case study exploring the development of CTS among preschoolers through the adoption of MI instructional approach. Therefore, no control groups were employed. This case study is not meant for proving that MI approach enhance the CTS development among children.

1.11 Chapter Summary

This chapter describes the needs to provide the opportunities for preschoolers to learn and to develop CTS, the essential skills for the 21st century. However, the problem with the present preschool education in Malaysia is that CTS is not integrated into the national preschool curriculum guidelines and as such, teachers do not make conscious effort to promote critical thinking in the classrooms.

Thus, the research objectives and questions of this present study are directed towards addressing the problem identified for this exploratory case study. The study is being conducted in one of the selected established private preschools which adopts MI theory as its teaching and learning approach. This adoption of MI as a teaching approach by the selected preschool provides the background for the researcher to explore the contribution of MI approach to preschool teaching in relation to the development of CTS for preschoolers.

The rationale of this case study touches on the deficiencies in the current practices of Malaysian preschools with regards to the explicit teaching and development of CTS in the preschool classrooms while the significance of this study for the stakeholders such as the preschool principals, teachers and educational policies makers, has been described.

This definitions for the specific terms used have been described theoretically and operationally within the context of this study which were provided towards the end of this chapter. The final section of this chapter highlighted the limitation encountered in this study and suggestions were made for the attention of future study.

The next chapter discusses on the literature reviews on various definitions of CTS, MI theory as a teaching approach in the context of preschool education as well as the infusion approach employed to allow the explicit teaching of CTS in the selected preschool classroom.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review in this chapter provided the researcher of this present study better understanding of the background and knowledge in line with the studies on critical thinking skills. It allowed the researcher to critically examine and analyse the past research studies conducted on the teaching and development of CTS among adults and young leaners in order to identify the research gaps or problem that need to be investigated. This literature review shown significant requirement of studies for exploring CTS development among younger children and this will be able to substantiate the contribution of this study.

This chapter begins with the broad and varied definitions of CTS by the various thinking experts, the various perspectives and components of critical thinking which lead to the work on attaining the consensual definition by a team of experts through APA Delphi Report (1990) in terms of the characteristics (cognitive skills) and elements (sub-skills) of CTS which formed a significant part of the theoretical frameworks of this study. The discussion then focuses on the role of CTS in education particularly on the teaching and development of CTS in preschool besides discussing the tools involved for assessing CTS among adults and young learners. It then proceeds on to discuss the various approaches employed for teaching the skills of critical thinking to young children such as the infusion approach in the perspectives of Swartz and Parks' framework.

Next, it discusses on how the instructional support materials (ISM) were designed and prepared as a form of support for enabling teachers to teach CTS in the classrooms and the application of such skills for problems solving. The discussion further included the employment of MI approach (which is based on MI Theory) as the pedagogy for implementing the ISM. Prior to the implementation of the ISM, MI profiling of preschoolers was conducted for the purpose of grouping students into various MI groups to facilitate the MI approach of teaching. The aspects of CTS application by preschoolers for problem-solving would also be discussed.

The researcher synthesised related literatures to generate a framework for teaching and developing core skills of critical thinking among preschoolers. This chapter included a section on identifying and filing in the gaps of study as well as the past methodologies related to the themes of CTS development among children and ends with a summary of directions for future study.

2.2 Definition of Critical Thinking Skills

Generally, the thinking experts view critical thinking as a pervasive academic literature term which tends to overlap among many broad definitions and as such it needs to be clearly or comprehensively defined by the experts for educationists, teachers or any layman to understand (Halpern 2014; Padget, 2013; Petress, 2004). The diversity of the definition stems from the fact that critical thinking was studied in various scientific related aspects and applied in multiple contexts which ended as overly general or vague to serve as definitions (Almeida & Franco, 2011, Doyle, 2012; Philley, 2005).

In a broad sense, many seemed to agree that critical thinking is an intellectual discipline and a cognitive capability that involves skillful, purposeful and in-depth thinking which is more than just thinking reflectively, logically and reasonably (Almeida & Franco, 2011; Ennis, 1981; Fisher, 2011; Nicoll, 1998; Scriven & Paul, 2003). Many thinking experts are opined that it engages much more complex processes which are often referred to the upper domain of Bloom's Cognitive Taxonomy such as analysis, synthesis and evaluation (Idol & Jones, 2010; Shaunessy, 2006) while some scholars linked critical thinking to higher order of reasoning or metacognition (Collins, 2014; Dam & Volman, 2004; Halpern, 2014; Kuhn, 1999; Phan, 2010).

The National Council for Excellence in Critical Thinking (a non-profit organisation based in the U.S.) provides a very basic concept of critical thinking as simply an act of taking charge of one own's mind which calls for the understanding and examining of how the mind works in order to monitor it, fine-tune it and modify it for better operations (The Critical Thinking Community, 2013).

John Dewey (1998; cited in Fisher, 2011), known as the "father" of modern critical thinking; characterizes critical thinking as the reflective thinking which involves giving active, persistent and careful consideration to all supporting 'grounds' of a belief. Similarly, Edward Glaser (1941; cited in Fisher, 2011; described critical thinking as a form of reflective reasoning which involves persistent and thoughtful ways of examining any form of belief or knowledge through appraising or evaluating all the supporting evidences leading to drawing warranted conclusions for solving problems. Robert Ennis (1996, 2011), the well-known advocator for critical thinking also iterates that critical thinking is a form of reasonable reflective thinking that is focused on deciding what to believe or do that results in effective decision making.

Yet there are other groups of thinking experts who defined critical thinking as a specific set of skillful thinking that is more than just reflective thinking. Mathew Lipman (1991) states that critical thinking is a skillful and responsible mode of thinking which relies on employing criteria as the instrument for making effective judgments. On the same note, Alec Fisher (2001; cited in Moon, 2008) referred critical thinking as a kind of skillful evaluative thinking which involves thinking both critically and creatively in order to produce quality reasoning or argument in support of a belief or a course of actions. In the same light, Robert Fisher (2005) refers critical thinking as a chain of skillful logical reasoning involving various levels of cognition such as knowledge, comprehension and evaluation of information that leads to effective decision making.

On top of that, thinking experts such as both Richard Paul and Michael Scriven (2003) described critical thinking as the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from or generated by observation, experience, reflection, reasoning, or communication, as a guide to one's belief and action (cited also in Padget, 2013).

On the other hand, Diane Halpern (2003, 2014) described rather comprehensively that critical thinking is a purposeful, reasoned and goal directed thinking which involves evaluating the thinking process (a form of metacognition) that should lead to desirable outcomes through formulating inferences, calculating possibilities and making decisions directed for effective problem solving, like wise; Deanne Kuhn (1999), the educational philosopher also refers critical thinking as an act of metacognition as it entails the thinking about one own's thinking whereby thinking is motivated by reasoning, reflection of the thinking itself and evaluation of the thinking that leads to "self-correction".

Working together with Linda Elder the educational psychologist; Richard Paul, further concurred with Diane that critical thinking begins when one begins to think about his or her own thinking and provide a practical description of critical thinking as the self-directed, self-disciplined, self-monitored and self-corrective mode of thinking whereby thinkers are to ensure that they skillfully apply the best thinking they are capable of in any circumstances in order to make the quality decisions with the relevant information gathered for solving problems in everyday life (Paul & Linda, 2014). Table 2. 1 is a summary of the various definitions of CTS.

Table 2.1
Different Definitions of CTS by Various Thinking Experts

Thinking Experts	*Definition of CTS*
John Dewey (1933)	Critical thinking is a form of active, persistent and reflective thinking which is given a lot of careful and intentional considerations.
Edward Glaser (1941)	Critical thinking is the attitude of logically and rationally consider alternative interpretations of information and evaluate the strengths of the arguments presented.
Robert Sternberg (1986)	Critical thinking is the ability to use cognitive processes, strategies or interpretations of information to solve problems, making better decisions or learning new concepts through many educational perspectives.
Peter Facione (1990)	Critical thinking as the consensual definition is the purposeful, self-regulatory judgement which is made based on various considerations that involves the six core cognitive skills of interpretation, analysis, inference, evaluation, explanation and self-regulations.
Mathew Lipman (1991)	Critical thinking is a skillful and responsible mode of thinking which relies on employing various criteria as the instrument for making effective judgments.
Robert Ennis (1996)	Critical thinking is a reasonable and reflective thinking which focuses on deciding what to believe or do.
Diane Halpern (1998)	Critical thinking is a purposeful, reasoned and goal directed thinking which should lead to desirable outcomes through formulating inferences and making decisions directed for effective problem solving.
Deanne Kuhn (1999)	Critical thinking is an act of metacognition of thinking about the thinking whereby thinking is motivated by reasoning, reflection of the thinking itself and evaluation of the thinking that leads to “self-correction”.
Richard Paul and Michael Scriven (2003)	Critical thinking is the mode of thinking that ensures thinkers improve the quality of thinking and skillfully apply the best thinking abilities.

Table 2.1 (continued)

Thinking Experts	*Definitions of CTS*
Stella Cottrell (2005)	Critical thinking is a form of cognitive activity, focusing on argumentation and reasoning through the use of the mind.
Richard Paul and Linda Elder (2006)	Critical thinking is a self-directed, self-disciplined, self-monitored and self-corrective form of thinking to make effective decisions.

However, there are experts such as Atkinson (1997, cited in Lin, 2014) who claimed that critical thinking is a non-definable educational concept while other experts are of the opinion that despite the challenges and difficulty, critical thinking is an important concept that should be defined in order to offer a clearer description to educators and learners (Lin, 2014).

To resolve the issue of overly diversified definitions, Facione and a team of forty-six experts from various disciplines were convened by American Philosophical Association (APA) to work on a consensual definition for critical thinking employing the Delphi Method (Facione, 1990; Facione, 2015; Nicoll, 1996). Through the Delphi report, Peter Facione (1990, 1992, 1998, 2004, 2006, 2011, 2013, 2015) and team provided the consensual definition of critical thinking as the purposeful, self-regulatory judgement which involves six core cognitive skills, namely: interpretation, analysis, inference, evaluation, explanation and self-regulations. Facione's Delphi's consensual definition will be further elaborated later in section 2.3.

Based on the discussions above and in the context of this study, the definition of critical thinking proposed by Facione (1990; 2015) and his team will be adopted whereby under the consensual definition; critical thinking is considered as a purposeful and reflective process involving the use of cognitive skills which aims at making rational and reasoned judgements leading towards effective decision making and problems solving. The aim of the present study is not only to develop cognitive skills of critical thinking, but also to encourage young students employ CTS through active engagement in everyday learning and real life's problem-solving which are considered as part of the lifelong endeavor (Halpern 1998; Lin, 2014; Scriven & Paul, 2003).

2.2.1 Various Perspectives of Critical Thinking Skills

In the past decades, critical thinking has been discussed in several perspectives or components by various thinking experts and were expected to share a better light on the wholesome skills of critical thinking. In the light of this tradition, Edward Glaser alleges that critical thinking is an ability which involves three components: (1) an attitude of thoughtful consideration on the problems and subjects within the range of one's experiences, (2) knowledge of the methods of logical inquiry and reasoning, and (3) some skills in applying those methods (Glaser, 1972; Fisher, 2011; Lin, 2014) while Swartz and Parks (1994) claim that there are three components in critical thinking which are teachable: (1) goals to critical judgement through the (2) skills of assessing the reasonableness of ideas with the (3) attitudes of being actively open-minded (Lin, 2014).

On the same note, other thinking experts such as Daniel Willingham (2007) also describes critical thinking as an ability of making inferences and decisions which comprises three features such as effectiveness, novelty and self-direction whereas, Fisher (2011), refers critical thinking as fundamental abilities to identify and analyze assumptions; evaluate, explain and make decisions.

On one hand, numerous thinking experts postulate that in addition to the skills and abilities; in order for one to be an ideal critical thinker, he or she must possess the appropriate dispositions of a good thinker such as open-mindedness, fair-mindedness, inquisitive, flexibility, the propensity to seek reason and be well-informed (Ennis, 2011; Facione, 2015; Halpern, 2014) while some other researchers argued that dispositions should not be included within the definition of critical thinking as they are simply desirable characteristics or qualities of good critical thinking (Doyle, 2012; Lai, 2011).

However, most experts somehow acknowledged that critical thinking are intellectual skills which need to be developed explicitly and through hard work (Halpern 1998 & McGuiness, 2000 as cited in Padget, 2013; Paul & Elder, 2014).

2.2.2 Components of Critical Thinking Skills

It was aptly described by Halpern (1998) that critical thinking is a complex and contested construct (cited in Padget, 2013:7), where it can be attributed partly as the cognitive skills associated with higher order thinking (Doyle, 2012); partly as the competency for one to convey ideas intellectually (Almedia & Franco, 2011), partly as the disposition of a good thinker who is fair-minded and diligent (Facione, 2015).

Doyle (2012) in her concept paper claimed that critical thinking includes three components: (1) cognitive skills such as analyzing, making inferences through inductive or deductive reasoning, evaluating, and making decisions for solving problems; (2) dispositions of thinking attitudes such as fairness, open-minded, inquisitive, flexibility and respect for others' opinions; (3) background knowledge which is essential yet not a sufficient condition for enabling critical thought within a given subject.

Lai (2011), in her literature review also pointed out that most researchers of critical thinking agreed that it primarily involves specific cognitive abilities such as analyzing, reasoning (inductive and deductive), judging and evaluating besides involving the relevant dispositions of good critical thinking skills such as open-mindedness, fairness, inquisitiveness, the desire and propensity to seek reasons, flexibility and respect for others' viewpoints.

In the context of this study's focus, development of one's critical thinking is being considered mainly from the perspective that it involves firstly the core cognitive skills for thinking before one can further develop and display the basic dispositions or characteristics of a good thinker.

2.3 Consensual Definition by APA (American Philosophical Association) – The Delphi Report 1990

Literatures reviewed that, despite decades of debate; the thinking experts have not been able to agree on one single common definition of critical thinking until 1990; through the research effort of a panel of forty-six experts lead by Peter Facione convened by the American Philosophical Association (APA); has conducted a two years' Delphi Study on critical thinking (Facione, 1990; Jones & Ratcliff, 1993; Nicoll, 1996). Through this study, the panel found that most of the experts' definitions on critical thinking do share some basic characteristics that address the various components of critical thinking and thus, they assented on a consensual definition for critical thinking skills which reflect the concepts (process), skills (cognitive abilities) and characteristics (dispositions) aptly (Bissell & Lemons, 2006; Nicoll, 1996; Potts, 1994). In short, based on the APA Delphi definition; critical thinking is a purposeful form of thinking and reflective judgement focusing on constructing effective decision or solution which involves the cognitive skills of interpretation, analysis, evaluation and inference as well as explanation upon which the judgement or decision made (Facione, 2015; Nicoll, 1996). However, Facione cautioned that the consensual critical thinking framework of the APA Delphi Report is in no way implied that there is any form of developmental progression or hierarchical taxonomy of the cognitive skills involved in contradiction to Kuhn's postulation of critical thinking skills as a developmental progression (Lai, 2011).

Deriving from this consensual definition, critical thinking is defined as a purposeful, in-depth reasoning and judgement which involves six core cognitive skills namely: (1) interpretation (understanding of the meaning of information and data), (2) analysis (identifying of the relationships between information or data), (3) inference (identifying elements required for drawing reasonable outcome), (4) explanation (being able to present one's reasoning coherently), (5) evaluation (assessing the credibility of information, data or judgments), (6) self-regulatory (monitoring and reasoning of one's thinking activities and judgments) which are central to critical thinking. Each of these cognitive skills with its respective criteria, is at the core of critical thinking.

The Executive Summary of the Delphi Report (Facione, 1990) documented the following consensus statement of critical thinking in terms of the core skills, sub-skills and dispositions:

(1) Six core cognitive dimensions of critical thinking: interpretation, analysis, inference, evaluation, explanation and self-regulation.

(2) Sixteen subskills of critical thinking: categorization, decoding significance, clarifying meaning, examining ideas, detecting arguments, analysing arguments, querying evidence, conjecturing alternatives, drawing conclusions, assessing claims, assessing arguments, stating results, justifying procedures, presenting arguments, self-examination and self-correction.

(3) Nineteen dispositions of critical thinking: such as inquisitiveness, alertness, self-confidence, open-mindedness, fair-mindedness, understanding, flexibility, honesty, well-informed, trust in the process, prudence in judgement, willingness to consider, clarity, orderliness, diligence in seeking information,

reasonableness, focused, persistence and precise (as per illustrated in figure 2.1 below):

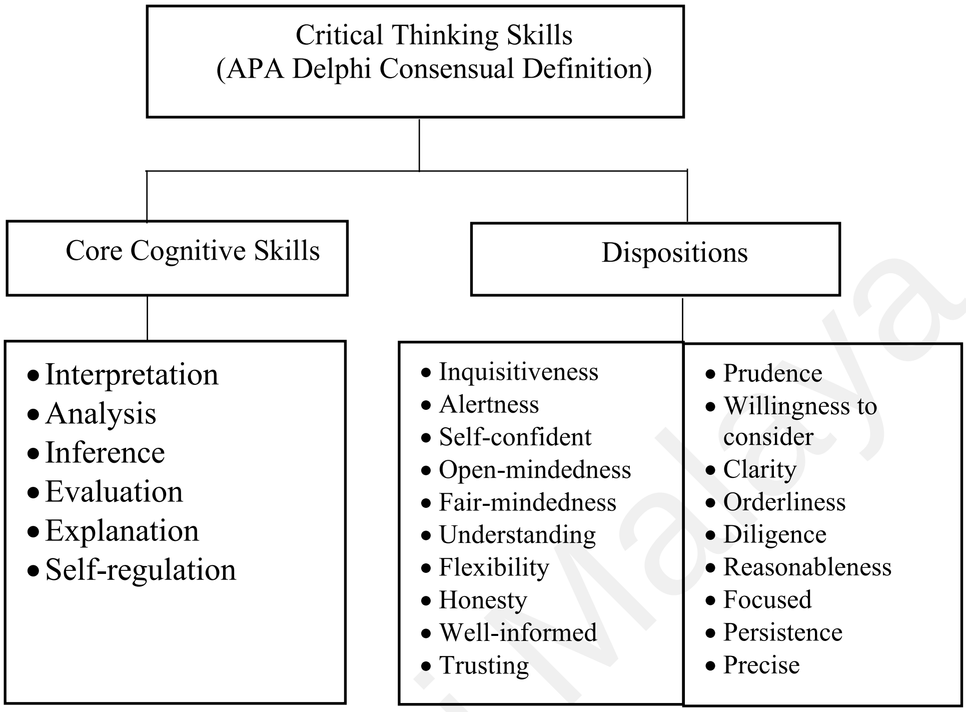


Figure 2.1 Summary of APA Delphi Consensual Definition of CTS (Facione, 1990)

The Delphi Report (1990) of the consensual definition of CTS asserts that CTS involves six major cognitive skills and in order for the critical thinking skills to be effective, they require important characteristics or attitudes known as “dispositions”. Both the cognitive skills and dispositions of critical thinking can be assessed through certain instrument such as CCTST- California Critical Thinking Skills Test (Facione, 1992).

Since the consensual definition by the experts was reached in 1990, till date; the executive summary of the Delphi Report on statement of critical thinking skills has been widely referred to by scholars for their studies of CTS as a twenty-first century competency (Lai, 2011; Lin, 2014; Nicoll, 1996; Živkoviü, 2016). Table 2.2. is the summary of the consensual definitions of critical thinking in the perspectives of core cognitive skills, subskills and dispositions adapted from APA Delphi Report: Experts

Consensus Statement on Critical Thinking (Facione, 1998; 2004; 2006; 2011; 2013; 2015).

Table 2.2
Definition of the Six Core Cognitive Skills of Critical Thinking.

Core-Cognitive Skills	*Descriptions*	*Subskills*
Interpretation	• To understand and assign meaning to data, information, situations, experiences, procedures or messages which may be in many forms, such as: charts, diagrams, maps, graphs, verbal and non-verbal expressions.	• *Categorisation* – to formulate frameworks for classifying and describing information or data provided. • *Decoding significance* – to identify and describe details of information, purpose, motives and expressions in relation to its relevance or importance. • *Clarifying meaning* – to describe or explain clearly the details or meaning of data or information through paraphrases, restructured statements, verbal or non-verbal expressions.
Analysis	• To identify, examine and consider details such as reasons, characteristics, concepts and evidences of descriptions, information, opinions and judgement in order to determine some forms of important patterns.	• *Examining ideas* – to compare and reason before determining the roles or relationship of various ideas, data, concepts or statements in order to reach an inference and outcome. • *Detecting arguments* – to identify and determine if various sets of information, expressions or reasons support or contest the claims or points of view. • *Analysing arguments* – to examine and verify if the claims and reasons either support or contest the intended conclusion or representations.
Inference	• To identify and draw conclusions to form conjectures from all evidences, observations, reasons and experiences in order to predict the consequences and assumptions which allow one to determine the logical possible outcomes of or intended decisions for a given situation.	• *Querying evidence* – to determine or judge the relevance or validity of all details, information and data before deciding the acceptability. • *Conjecturing alternatives* – to formulate multiple hypotheses or possibilities regarding a situation in order to develop a variety of plans to counter the situation. • *Drawing conclusions* – to apply or employ various possible and appropriate modes of reasons which are strongly supported by various evidences at hand for determining conclusions.

Table 2.2 *(continued)*

Core-Cognitive Skills	*Descriptions*	*Subskills*
Evaluation	• To assess the credibility and quality of any arguments, explanations or claims which are accounts of one's perception, experience, belief, judgement or opinions.	• *Assessing claims* – to recognise and examine the factual, contextual relevance and the degree of acceptability or truth of the source of information, data, details or opinions. • *Assessing arguments* – to judge and determine the reliability and acceptability of the assumed conclusions or justifications of an argument.
Explanation	• To justify and present the results of decision or choices made basing on evidences, concepts, criteria, context and methods employed.	• *Stating results* – to provide reasons for one's choices or decisions through accurate descriptions and statements. • *Justifying procedures* – to describe and record how one forms or executes the processes of interpretation, analysis, inferences and evaluation. • *Presenting arguments* – to justify and describe the reasons for one's claims or decisions made.
Self-Regulation	• To consciously monitor and examine the effectiveness and results of one's own cognitive activities in order to take self-correction measures.	• *Self-examination* – to reflect and assess on the execution or application of one's own cognitive skills or decisions. • *Self-correction* – to prepare and provide remedy or rectification for decisions or solutions based on one's own effort.

The six core cognitive skills of critical thinking as identified by APA Delphi Study (1990) are the focus of the purposeful reflective judgement about the "what to believe" and "what to do" in the everyday life (Facione, 2015; Hamby, 2013). These cognitive core skills are not used in isolations or against each other as almost all of the daily thinking tasks involve the usage of most if not all of the six cognitive skills (Facione 2015; Hamby, 2013). In another words, based on the APA Delphi consensus definition of CTS, the skills of critical thinking operate as a whole or in totality with the involvement of most if not all of the six core cognitive skills.

Nicoll (1996), in her study claimed interpretation, analysis, inference and explanation as the four core cognitive skills of critical thinking which are developmentally appropriate for young children. However, in the latest study by

Insight Assessment (2017), evaluation is also appropriate for the young children's development in addition to these four cognitive skills. As such, the researcher of this present study opted to investigate on the development of these four core cognitive skills of critical thinking: interpretation, analysis, inference and evaluation (which requires the skill of reasoning and explanation from time to time) as per advised by Dr. Carol, expert of critical thinking for young children (Insight-assessment, 30 September 2017).

Although, the discussion of thinking dispositions was also an integral component of this APA Delphi Study, it will not be deliberated in this study as the focus of this study is on the development of the cognitive aspects of critical thinking in which the consensual definition of the Delphi Report would be referred as a general reference for this study.

As such, in the process of preparing the learning activities infused CTS (which are based on the multiple intelligences theory) as the instructional support for the six years old preschool classroom; the list of skills and sub-skills of critical thinking which were identified and deemed by the group as appropriate for the development of critical thinking among preschoolers will be adopted and modified in accordance with the context of Malaysian Preschool settings.

2.4 Role of Critical thinking Skills in Education

The twenty-first century recognises critical thinking as the primary objective of education (Halpern, 2014). Critical thinking is deemed as a liberating force in education and a powerful resource in one's personal life which allows one to be involved enthusiastically in life-long learning (Facione, 2015). It is undeniably the most essential competency for the twenty-first century and thus becomes the most integral part of education in preparing a thinking generation for the future workforce (Collins, 2015; Doyle, 2012; Halpern, 2014; Lai, 2011; Melo, 2015). People with strong critical thinking skills tend to be quality thinkers (Educate Insight, 2018).

Many studies have been conducted on critical thinking from various perspectives of philosophy, psychology and education; the field of education seem to have benefitted much in the aspect of teaching and learning processes (Almeida & Franco, 2011; Davis-Seaver, 2000; Phan, 2010). While the content being learned may be elementary, the student's ability to reason about that material, to analyze it, to draw inferences about it, and to evaluate claims in the light of that knowledge are vital parts of the child's education. Back in 1992, Giroux(cited in Davis-Seaver, 2000) has described critical thinking as “a radical tool” of education that learners can apply for life and not just a set of facts to be memorized or retold and be forgotten after a certain period of time.

Liu, Frankel and Roohr (2014) reported that in the surveys conducted by Casner-Lotto and Barrington (in 2006); AAC&U (Association of American Colleges and Universities in 2011) and ETS (Educational Testing Service in 2013) with various entities such as education administrators of higher institutions, employers and policies makers; close to ninety percent (90%) of them gave a resounding confirmation that critical thinking as the most important intellectual skills or core learning outcomes of education for all the students in order to prepare them as the successful workforce.

Acknowledging that the development of critical thinking skills is both essential and crucial for the twenty-first century, the Malaysia Education Blueprints (2013-2025) places one of its main emphasis on the teaching and development of higher order thinking or critical thinking for both the primary and secondary school education. The teaching and development of CTS is given further emphasis in Malaysia’s preschool education through the implementation of the revised National Preschool Curriculum Standard in January 2017.

2.4.1 Teaching and Development of Critical Thinking Skills in Preschools

Developing thinking skills in the classroom is important for supporting students' cognitive processing, helps them learn better and equips them to deal critically yet systematically with novel problems and to communicate effectively (McGuiness, 1999).

Some studies reveal that applications of thinking skills are more common in secondary schools and colleges which in return suggests that it is rather lacking in primary or even preschools education (Davis-Seaver, 2000) but in general, experts and scholars concede for critical thinking skills to be taught by teachers directly or explicitly either inside or outside the classrooms through daily learning activities or extra-curricular programmes which involves thinking skills to effectively promote the thinking culture and habit among young children (Doyle, 2012; Facione, 1999; Lai, 2011; Melo, 2015; Taggart et al, 2005). Kuhn (1999 cited in Doyle, 2012 and Lai 2011), in her study also affirms that critical thinking as a form of metacognitive development can be and should be taught to young children during early years.

Indeed, empirical evidences show that children as young as three and four years old are capable of thinking critically (Lai, 2011) despite their knowledge and experience may be limited but their mental capabilities are sufficient for them to think (Davis-Seaver, 2000; Dowling, 2013). Thinking expert, Davis-Seaver (2000) stresses that critical thinking is not only developmentally appropriate for young children; but it is also a developmental necessity. Children begin to engage in critical thinking when they use reflective reasoning and analysis skills to internalize classroom learning and experiences, interpreting information received, analyzing situations encountered as well as evaluating reasons for their choices of options. They then further engage in more critical thinking as they approach problem solving and decision making in their daily lives by strategizing solutions through applying prior experience and anticipate potential options or forming inferences (Educate Insight, 2018).

In relation to the CTS development in young children, Jean Davis-Seaver (2000) and Silvia (2008) strongly believed that very young children possessed the readiness and the cognitive abilities to think critically. To encourage the development of critical thinking of young children, teachers should include explicit thinking instructions in the classroom, to promote thinking language and provide opportunities for deeper thinking (Birbili, 2013; Lai, 2011). Dowling (2013) concurs young children who have the aptitude and attitude as competent thinkers need to be supported by thinking opportunities or intervention which help to compensate the gap between their experience and development.

Malaysian scholars also strongly suggest that the teaching of critical thinking skills to students ought to begin at the preschools and progress to primary or secondary schools; that teachers are required to be well-trained and equipped with the mentality or capabilities to teach thinking skills to their students for the purpose of developing thinking individuals (Amalina Muirah Mohamed Zabidi & Suryani Nik Abd Rahman, 2012; Wirawani Kamarulzaman & Ismail Sheikh Ahmad, 2014). In fact, Wong and Yeo (2014) in their study states that the teaching of critical thinking skills in early years help to stimulate and challenge young children's intellectual whom in return become more motivated and engaged in effective learning. Other more recent scholars such as Dowling (2013) and Robson (2012) also claim that the consequence of teaching young children to think sets as a precursor to better future achievements.

Assenting that teachers are responsible for teaching children to think by creating the learning environment that stimulates critical thinking (Collier et al., 2002); some researchers advocate for thinking routines from Zero Project to be adapted and implemented as the developmentally appropriate thinking interventions in the classrooms for young children claiming that they can benefit much from such implementation (Salmon & Lucas, 2011).

2.4.2 Assessing Critical Thinking

Children may have limited knowledge and experience, they however apply their CTS to analyze information, interpret situations, evaluate the credibility of claims and assess the reasons of why they should think or what to do in the everyday living. The quality of their thinking and making decisions depends very much on the strength of their CTS which can be assessed (Insight Assessment, 2017).

The study conducted by Gadzella and Richard in 2001 (cited in Collier et al., 2002) states that assessment of children's thinking skills tends to be more feasible of the qualitative nature as the appropriate tools for measuring the development of CTS are rather scanty or yet to be developed. Facione (1992, 1998, 2004, 2006, 2011, 2013, 2015) in his studies claimed that the skills of critical thinking are abilities or proficiencies engaged by individuals to execute purposeful reasoning and evaluating processes for better decision making or problems solving; these skills can be taught and thus should be able to be assessed through various measures.

In this light, Programme for International Student Assessment (PISA) sponsored by the Organisation for Economic Co-operation and Development (OECD, 2012) has been employed as one of the more popular assessment tool which employs multiple units of testing format consists of texts, tables or graphs which includes multiple-choice, short answers and longer constructed responses for measuring critical thinking as a core competency when evaluating general learning outcomes among teenage students across numerous nations.

However, Ku (2009) warns that critical thinking tests utilizing a single multiple-choice response format measures only recognition or level of knowledge, and do not adequately capture the dispositional characteristics of test-takers. In agreement with other researchers such as Halpern and Bonk and Smith; Lai (2011) reiterates that assessment for critical thinking which is based on tasks, simulations and plausible real-life related problems or issues are more recommendable.

Although there are numerous established tools for measuring the critical thinking skills of the older students and adults despite the complexity and issues of validity and reliability; many experts agreed that it is most challenging to assess children's critical thinking skills given that there is yet an existing assessment tool for that purpose (Collier, Guenther& Veerman, 2002; Facione, 2015; Lai, 2011).

According to Swartz and McGuiness (2014), there are about two general principles considered by most of the CTS assessment tools: (1) the psychometric approach where critical thinking is considered as a personal ability which can be tested separately in a single testing session similar to an intelligent testing; (2) the curriculum approach where critical thinking is considered as an ability which manifests itself in the context of students' work or learning.

In general, there are about six commonly known assessment tools developed by the thinking experts over the years which are used for measuring the critical thinking abilities of the older or adult learners:

(1) Watson-Glaser Critical Thinking Appraisal (WGCTA) by Goodwin Watson and Edwin Glaser (1980); which is based on the "RED" (recognise assumptions, evaluate arguments and draw conclusions) model.

(2) Ennis & Weir Critical Thinking Essay Test (CTET) by Robert H. Ennis & Eric Weir (1985) which measures six areas of critical thinking competence such as getting to the point, seeing reasons and assumptions, stating one's point, offering good reasons, seeing other possibilities, responding appropriately.

(3) The California Critical Thinking Skills Test (CCTST) by Peter Facione (1990) which assesses the six core cognitive skills (interpretation, analysis, inference, evaluation, explanation and self-regulation) of critical thinking.

(4) The Cornell Critical Thinking Test (CCTT) by Robert Ennis and Jason Millman (2005) which helps to evaluate and determine students' abilities in critical thinking.

(5) Online Critical Thinking Basic Concepts Test by Linda Elder, Richard Paul and Rush Gosgrove (2007) which measures the extent of students' understanding regarding the fundamental concepts of critical thinking.

(6) The Halpern Critical Thinking Assessment (HCTA) by Diane Halpern (2010) which assess the five dimensions of critical thinking such as verbal reasoning, argument analysis, thinking as hypothesis testing, likelihood and uncertainty, and decision making and problem solving.

Table 2.3 (on page 52) is a summary of some of the existing critical thinking assessment tools which are rather well established and have been popularly used by various institutions to assess the skills of critical thinking among the older learners:

Table 2.3
Summary of the Various Assessment Tools for CTS

Year	*CTS Test*	*Descriptions*
1980	Watson-Glaser Critical Thinking Appraisal (WGCTA)	• Created by Goodwin Watson and Edwin Glaser. • Based on "***RED***" (recognize, assumptions, evaluate arguments and draw conclusions) model
1985	Ennis and Weir Critical Thinking Essay Test (CTET)	• Designed by Robert H. Ennis and Eric Weir • Measuring six areas of competency in critical thinking: Get to the point, understand reasons and assumptions, claiming one's point, providing good reasons, accepting other possibilities, responding appropriately
1990	California Critical Thinking Skills Test (CCST)	• Designed by Peter Facione • Assessing six core skills of critical thinking: interpretation, analysis, inference, evaluation, explanation and self-regulation
2005	The Cornell Critical Thinking Test (CCTT)	• Created by Robert Ennis and Jason Millman • Assessing and determining students' abilities in critical thinking
2007	Online Critical Thinking Basic Concepts Test (OCTBCT)	• Created by Linda Elder, Richard Paul and Rush Gosgrove • Measuring the extent of one's understanding regarding the fundamental concepts of critical thinking
2010	The Halpern Critical Thinking Assessment (HCTA)	• Created by Diane Halpern • Assessing the 5 dimensions of critical thinking: verbal reasoning, argument analysis, thinking as hypothesis testing, decision making and problem solving.

Besides the various established assessment tools of pencil-and-paper tests, scholars also suggested a few practical ways of assessing the critical thinking skills such as observing how individuals perform thinking activities or comparing outcomes of how individuals execute thinking proficiencies (Collier et al, 2002; Facione, 1990; Lai, 2012).

There is yet to be any well-established assessment instruments or tool available for assessing the CTS of young children below eight years of age. Not until the middle of 2017 when '*Insight Assessment*' (the commercial owner of CCTST) led by Peter Facione and Carol Gittens (authors of "Think Critically"); managed to develop the set of CCTST meant for the K2 young children (six-year-old preschoolers) which was released for trial in September 2017.

The K2 CCTST takes on the format of multiple-choices questions related to everyday scenarios of the real world relevant to the target developmental age of five to six years old. This test questions invite preschoolers to interpret and analyse information or data, draw appropriate or suitable inferences as well as to evaluate inferences drawn and explain on decision made. Further explanation on the preparation and administration of the pre and post CTS assessment is included in Chapter Four – Methodology.

In relation to the purpose of this study, the researcher will adopt the CCTST Model for assessing the level of critical thinking skills among the young children. The CCTST assessment model seems to capture both the analytical and synthetic dimensions of critical thinking with clear operational definitions (Liu et al, 2014) for each of the core cognitive skills involved besides contextualizing it to real life scenarios which are familiar to young children.

2.5 Approaches for Teaching Critical Thinking Skills

This section discusses about the various pedagogical approaches for teaching critical thinking in the classroom highlighted by numerous literatures. While researchers and thinking experts maintain that skills of critical thinking are not just caught but need to be taught among students in schools, the bigger challenge is then to identify the approaches and methods for teaching these skills (Lai, 2011; Padget, 2014). Over the years, discussions have been centred around these four broad approaches:

(1) The "***generalist approach***" which involves the '*teaching of critical thinking'* skills as a separate course through direct and explicit instructions whereby specific programmes or resources employed (such as Blagg's Somerset Thinking Skills and Bono's CORT) are specially designed materials which are curricular context-free and separate from the school curriculum (Lai, 2011; Lin, 2014; McGuiness, 1999; Perkins & Swartz, 1991). This approach is also referred to as the "discrete approach" by some scholars as specific resources or techniques are used for the teaching of critical thinking skills (Lin, 2014; Perkins & Swartz, 1991; Taggart et al. 2005). The generalist approach does not require contents from subject-matters or discipline-specific knowledge (such as mathematics or science) instead it is content draws from issues around students' daily lives such as local political issues, problems in school canteen or a flash flood (Ennis, 1989; Lai, 2011).

(2) The "***subject specific approach***" which involves the '*teaching for critical thinking'* skills through in-depth, thoughtful and well understood instruction (Ennis, 1989) of promoting and enhancing skillful, higher-order or higher-quality thinking (such as reasoning and problem solving) within regular content curricular subjects or in an academic context such as mathematics and

science whereby students are taught to focus on domain-specific thinking like logical-mathematical thinking (Lin 2014; McGuiness, 1999; Perkins & Swartz, 1991). This approach takes on the view that high quality thinking or critical thinking is inevitably linked to knowledge structures and the ways of thinking domain-specific whereby expertise in one area may not necessarily excel in the same way in other areas (McGuiness, 1999).

(3) The "***embed approach***" which attempts to capture an 'in-between' of both the "generalist approach" and "subject-specific approach" (McGuiness, 1999) by embedding CTS into the standard courses or standard subject contents (Ennis, 1989). This approach enables the learning of subject matter while keeping the core cognitive skills development in-tag (McGuiness, 1999). Two examples of "embed approach" are: (a) *Infusion*, in which general principles of critical thinking involving both abilities and dispositions are made explicit as part of the content in the subject matter instruction across curriculum (Ennis, 1989; Lai, 2011) with content of instruction directed at stimulating students' thinking abilities specifically (Perkins & Swartz, 1992). (b) *Immersion*, on the other hand; does involve in-deep subject matter instruction which is similar to "infusion" where students get immersed deeply but *without* the general principles of critical thinking abilities and dispositions being made explicit (Ennis, 1989; Lai 2011).

On the other hand, several scholars ascertain that the methodology of infusion can be subject-specific as CTS can be infused and taught explicitly in subjects such as mathematics, science, history and language among the few (Aizikovitsh & Amit, 2010; Ennis, 1989; Lin, 2014).

(4) The “***mixed approach***” which involves both “*teaching of thinking*” and *“teaching for thinking*” through combining the “*generalist approach*” and “*subject-specific approach*” of either “infusion” or “immersion” of critical thinking instruction (Ennis, 1989). Proponents of “mixed approach” such as Sternberg (1987), Nickerson (1988), Perkins and Salomon (1989) (cited in Ennis, 1989) have suggested for teachers to incorporate general critical thinking principles as well as application of critical thinking into the context of specific subjects through explicit instructions and through involving the everyday issues encountered by students. This approach is somehow well supported by Facione (1990, cited in Lai, 2011) as he acclaims that CTS can be taught to students in both the context of subject-specific explicit instruction and as well as in the context of contents drawn from students’ daily life experiences.

2.5.1 Infusion Approach for Teaching Critical Thinking Skills

According to the past literature review by Taggart et al. (2005), in the preschool setting, two main categories of classroom-based approaches for teaching CTS were highlighted; (1) the “infusion approach” in enhancing or teaching CTS within everyday lessons and (2) the “discrete approach” where specific programmes or techniques were used to teach CTS. However, previous studies implied that majority of the thinking experts such as Glaser (1985), David Perkins(1991), Robert Swartz (1991), Lisa Martin, Diane Halpern (2005) and Carol McGuiness (2007) are in favour of the infusion method as students are found to have benefitted much from the explicit teaching of CTS across a wide range of existing curricular whereby curricular content and thinking skills can be taught and learnt together (Ennis, 1997; Lai, 2011; Padget, 2014; Sedaghat & Rahmani, 2011). Taggart et al (2005), in their literature review also concurs that “infusion approach” is a more preferred approach for teaching thinking skills especially so in the early years as “early years teaching” practices integrating or infusing skills (in this case, core skills of critical thinking) with knowledge (refers to subject-contents) within those themes and topics which are of interest to young children or related to their everyday experiences (Aubrey et al., 2012; Birbili, 2013).

Perkins and Salomon (1989) and Robert Swartz (1991) further argued that under the “discrete approach” of adopting specific or separate programmes and courses to bring explicit teaching of CTS, the application or transfer of the thinking skills learnt into the academic aspects is less automatic and less authentic as compared to infusing the instruction on thinking into standard lesson contents.

The “infusion approach” which involves both the direct and explicit instruction for the teaching of critical thinking skills or strategies as well as using teaching-learning methods (such as collaborative learning, inquiry learning or higher-order questioning) to promote the principles for critical thinking in the context of specific subject content area whereby the “critical thinking skills” are infused or embedded across all areas of curriculum (Aizikovitsh & Amit, 2010; Lai, 2011; Lin, 2014; McGuiness, 1991). In short, lessons used in this approach are designed for teaching both the thinking skills and the curriculum content simultaneously through a mode known as “infused curriculum” or “infused lessons” (Padget, 2014; Swartz, 1991; Swartz & McGuiness, 2014).

Infusion approach is seen as the natural way to structure lessons within the curriculum area to blend the teaching of thinking skills and learning of subject-specific contents together (Swartz, 1998; Swartz, 2008). According to McGuinness (2014), the approach of infusing thinking skills into content instruction serves as the primary vehicle for introducing CTS (including the core cognitive skills) to students as well as providing them the opportunity in using those skills. In this sense, the infused lessons are crafted to integrate core thinking skills into the subject content and to be taught explicitly at the same time (Mohamad Ahmad Assaf, 2009; Swartz, Fischer & Parks, 1998).

An ideal way of infusing or integrating the thinking skills or CTS across all areas of the existing curriculum, in this context, the preschool curriculum; is to create a "thinking curriculum" within the existing curriculum where lesson contents and skills like analyzing, interpreting, classifying, reasoning and problem solving are simultaneously pursued or learnt (McGuiness, 1999).

There is evidence that infusion approach enables a variety of core skills of critical thinking to be embed and taught across a wide range of existing curricular content instruction thus allowing students to learn critical thinking skills in all aspects of their academic subjects (Sedaghat & Rahmani, 2011; Swartz & McGuiness, 2014; Swartz & Parks, 1994). Swartz and McGuinness (2014) further claim that infusion approach is expected to be effective when the teaching of thinking skills is complimented with explicit thinking strategies in the content lessons, scaffolded by teachers' guidance, intense engagement of students in strategic planning and reflective metacognition.

In the school context for teaching critical thinking, numerous scholars opted to adopt the infusion approach instructional framework by Swartz and Parks (1994) as this model provides a good strategy for teachers to reprocess and restructure the prescribed content of the existing curriculum for integrating the teaching of critical thinking into the daily lessons (Assaf, 2009; Aizikovitsh & Amit, 2010; Sedaghat & Rahmani, 2011).

2.6 Instructional Support Materials (ISM)

Instructional support materials can be broadly described as learning activities which serve as tools for supporting teacher's teaching and students' learning. An instructional support can also be employed as the means of multiple interventions which will enhance the content knowledge in order to scaffold better development of skills and learning among students (Foong, 2012; McNeil, Lizotte & Krajcik, 2006).

In the context of this present study, instructional support materials are specially designed learning activities for the daily lessons of the selected subjects (English Language, Science or Mathematics), incorporated with four core skills of critical thinking to encourage the development and learning of CTS across the content knowledge of those subjects concerned.

Scholars highlight that teachers play a very important role in the intervention exercise of enhancing students' thinking skills. While preparing instructional support materials, teachers should be able to contextualize learning, provide guided discussions and approachable tasks for students - stimulating them to practice thinking such as integrating and synthesizing information, accessing and evaluating resources, making inferences as well as making reasoned judgement and decisions for solving problems (Bowers, 2006; Foong 2012; Synder & Synder 2008).

The researcher of this study deliberates that specially designed or tailor-made instructional support material (ISM) is necessary and crucial for preschool teachers, particularly so in teaching CTS explicitly to preschoolers in the preschools of Malaysia. The much-expected teacher-guide or related teaching materials are not available to support the teaching of critical thinking skills in the preschool landscape. Besides, thinking-curriculum or thinking-lessons or thinking-activities samples are not evident in the recent upgraded official document of the national preschool standard-based curriculum (Malaysia).

Further to the above deliberation of tailor-made instructional support material (ISM) for teaching CTS to the preschoolers, the researcher of this study is also considering the support of a widely recognized instructional framework or technique, better known as Multiple Intelligences Teaching Approach or MIA as an effective approach for teaching the diverse students in the preschool classroom (Borek, 2003; Noble, 2004; Zobisch et al, 2014).

2.7 The Multiple Intelligences Approach (MIA) for Teaching

Since the introduction by Dr. Howard Gardner in 1983, Multiple Intelligences Theory has drawn great attention and resonation from thousands of educators who described it as a philosophy of education as well as an attitude or framework towards effective teaching (Zobisch et al., 2014). Educators around the world begin to move from the conventional teaching approaches of "one-shoe fits all" model and migrate to the more vibrant, enhanced as well as effective ways of teaching and learning for the diverse learners as proposed by the Theory of Multiple Intelligences (Chapman, 1993; Nwagu & Nwagu, 2013; Tajularipin Sulaiman, Abdul Raub Abdurahman & Susieleez Syrene Abdul Rahim, 2010; Weber, 2000).

Over the years, MI theory supporters have explored into many ways of teaching to provide a broader learning experiences for individuals with different areas of intelligences towards optimum learning outcomes in and out of the classrooms (Armstrong, 2009, 2017; Chapman, 1993; Gardner, 1993; Kagan, 2000; Nicholson-Nelson, 1998).

Armstrong (2009, p. 72) states that the MI theory has opened the door to a wide range of teaching strategies that can be easily implemented in the everyday classroom. Through the decades of continuous studies, the framework or model of Multiple Intelligences teaching approach is valued as an avenue for offering a broad opportunity of enhanced teaching to children of diverse learning abilities in a classroom setting (Weber, 2000; Zobisch et al., 2014).

Table 2.4 below illustrates a brief description of the eight different areas of intelligences and the preferred learning activities which are in correspondence to their respective areas of strengths.

Table 2.4
The Eight MI Strengths and Preferred Learning Activities (adapted from Nicholson-Nelson, 1998; Armstrong, 2009).

Area of intelligence	*Strengths of intelligence*	*Preferred Learning Activities*
Verbal Linguistic	The ability to perceive, think and express well in words, languages; either written or spoken. Enjoys analyzing information and communicate effectively.	Reading, telling stories, writing, spelling, word games, dialogues, discussions, questions and answers, rhymes.
Logical-Mathematical	The ability to think using logical reasoning, appreciate numbers, analyse abstract relations or concepts, discern logical and numerical patterns well. Enjoys asking questions.	Solving puzzles, science experiments, sequencing, manipulatives, calculating, number games, mathematical quiz and analyzing data.
Visual-Spatial	The ability to perceive, think and express in visual or pictorial forms. Observant and creative. Enjoys transforming and recreating images or illustrations.	Art and craft work, drawing and paintings, visual puzzles, videos, movies, picture metaphors, daydreaming, designing and visualization.
Musical-Rhythmic	The ability to perceive, think and express oneself through music and rhythm. Sensitive to patterns of rhythm, pitch and beats. Enjoys making sense from sounds and rhythm to compose or create music and songs.	Singing, rap, tapping to rhythm and beats, playing musical instruments, snapping fingers, whistling, humming, listening to songs, creating new tunes or songs.

Table 2.4 *(continued)*

Area of intelligence	*Strengths of intelligence*	*Preferred Learning Activities*
Bodily-Kinesthetic	The ability to communicate and express using the body parts. Coordinate and create various bodily movements, skillfully manipulate objects through good body control.	Playing sports, physical or hands-on activities and games, role play, handy crafts, sign language, facial expressions, dancing and acting, handling tools.
Naturalist-Environmentalist	The ability to understand and appreciate nature and natural phenomena. Good at identifying, distinguishing and classifying flora and fauna. Love and care for animals, plants and environment.	Gardening, field trips, nature walk, hiking, pets keeping, exploring nature and living things, outing at parks/farms/ seaside, experiments and observing living things.
Intrapersonal	The ability to self-reflect and understand one own strengths or weaknesses, sensitive to own moods and express own feelings accurately, using self-understanding for decision making or goal setting and learn from own mistakes.	Reflection, self-directed or individual project, daydreaming, goal setting, journal or dairy writing, imaginations, individual hobby.
Interpersonal	The ability to appropriately and effectively interact with other people, understand and motivate others well, sensitive to feelings and moods of other people, work well with people.	Group activities and projects, playing team games, group discussions and projects, peer learning, leading and directing projects, role-plays, community activities.

In the recent decades, MI theory has been widely adopted by educators for effective and innovative teaching in schools (Dastgoshadeh & Jalilzadeh, 2011; Lee, Rio Sumarni Shariffudin & Nora Mislan, 2012; Zobisch et al., 2015) as well as enhancing the cognitive development in early years education (Delgoshaei & Delavani, 2011). While Armstrong (2009, 2017) refers to the adoption of MI theory for teaching as MI teaching strategies; Dr. Ellen Weber (2000), introduced the terminology of MITA (Multiple Intelligences Teaching Approach); a brain-based approach which she has developed basing on MI theory to foster innovative teaching, leading and learning.

There are also other scholars who use other terminologies related to MI approach in education such as MI based curriculum or MI teaching (Dastgoshadeh & Jalilzadeh, 2011), MI techniques in teaching (Zobisch et al., 2015). However, the researcher of this study refers to the teaching or learning strategies in the preschool classroom which are based on MI theory as MI Approach (MIA). Furthermore, the preschool selected for this study has been using "MIA" as the terminology for its teaching and learning strategies over the past fifteen years.

2.7.1 Teaching to Students' Multiple Intelligences

Armstrong (2009, p. 54) states that "MI theory makes its greatest contribution to education by suggesting that teachers need to expand their repertoire of techniques, tools, and strategies …." beyond the conventional classroom of "chalk and talk". The MI Approach (MIA) is seen as a change of instructional technique which uniquely requires teachers to structure and design a variety of lessons and teaching strategies (instead of one fixed way of talking at children) to address the eight different areas of intelligences or different intellectual profile of each child to enable the achievement of optimum learning outcomes (Armstrong, 2009; Carreiro, 1998; Chapman, 1993; Lunenburg & Lunenburg, 2014; Zobisch et al., 2014).

Numerous scholars concurred that through use of MIA as the strategy for teaching in the classroom, teachers are able to broaden the opportunities of authentic learning experiences which address the different learning strengths or preferences of all the learners and is believed to promote effective learning (Lunenburg & Lunenburg, 2014; Nwagu & Nwagu, 2013; Zobisch et al., 2015). According to the theory of MI, there are at least eight different ways of approaching a topic of any particular subject or skill (Armstrong, 2009 & 2017).

Gardner (1999), suggests that among the eight multiple intelligences in each individual; there is/are usually one or two strongest areas which become(s) the strengths and learning strengths or preferences of the individual. The goal of MIA is to enable students of various learning preferences acquire deeper understanding of a subject matter through multiple teaching and learning strategies offered. For example, teaching children who display very strong verbal-linguistic intelligence, a teacher can use strategies such as storytelling, nursery rhymes, word games or spelling games, choral reading and discussions to approach a subject matter such as Mathematics, Science and English Language. However, for children who are strong in not just one single strength but in a few areas of intelligences such as verbal-linguistic and bodily kinesthetic intelligences; a teacher can then use the storytelling strategy with add-on role-plays, nursey rhymes with add-on hand-movements, word games or spelling with add-on actions (such as writing in the air), choral reading with add-on body-movement and discussions with add-on facial expressions (such as showing emotions, blinking of eyes, frowning etc.).

As Kagan (2000) well describes that there's no teaching or learning activity which engages only one area of intelligence and when children participate in any one activity; there will be interaction of various intelligences. Thus, through employing multiple strategies in any of the teaching and learning activities, the teacher provides an interconnected structure for all children with different learning preferences to be included in a variety of learning activities which engage a rich amalgamation of various intelligences of a lesson (Nicholson-Nelson, 1998).

A teacher who is well-verse with MI strategies for teaching, is prepared to organize a balanced variety of learning activities using multiple learning materials; ranging from brainstorming or discussions (linguistic), classifying picture metaphors (visual), singing a song or a rap (music), using hands-movements (kinesthetic), analyzing data and information (logical), organizing outdoor activities (naturalist), expanding children's imagination (intrapersonal) and assigning team projects (interpersonal) for any one particular lesson on any topic (Armstrong, 2009, 2017). In this manner, the MI teacher is able to provide a wide variety of learning experiences on one topic to significantly reach all the children with different learning preferences or strengths in one classroom through one or more lessons (Armstrong, 2009, 2017; Zobisch et al., 2015).

Besides, the MI teacher is expected to assess the learning outcomes of children through more authentic measures basing on each's different strengths through their participations and achievements in the various learning activities at the end of the "MI lessons". In another word, MI teachers do not assess children using the conventional rigid means of 'fill-in-the-blanks' form of written test or multiple-choice assessment alone (Gardner, 1993b). Instead, the MI teacher uses assessments means which are in context with the eight areas of intelligences; to probe children's understanding of learning of subject matters such as using the MI checklist, creating MI portfolios, documenting observation records and having dialogues with children to assess children's strengths, learning preferences and learning outcomes (Armstrong, 2009, 2017; Mehta, 2002).

In conclusion, by adopting MI approach as a change of instructional practice for preschool teaching and learning; teachers can now deliver every lesson through a few modalities in and out of the classroom. In another word, conventional lessons can now be presented in a variety of strategies for children to be exposed to multi-spectrum of learning experiences. In this context, children are expected to benefit from optimum learning outcomes in correspondence to their eight areas of multiple intelligences.

2.7.2 Profiling of Students' Multiple Intelligences

Ghamrawi (2014) in her study reveals that educators are drawn to identify preschoolers' areas of strengths or predominant multiple intelligences (Metha, 2002) through the use of observational checklist specifically generated to profile their various multiple intelligences as per practiced by the teachers in the Project Spectrum of the Harvard Project Zero. MI profiling is also referred to as MI survey by other scholars such as McKenzie and MI survey has been widely used by many teachers in the preschool settings (Ghamrawi, 2014) while Armstrong (2009), prefers the use of MI checklist to assess and describe children's MI or inclinations towards certain areas of intelligences.

Besides identifying the strengths or proclivities and learning preferences of each young student or preschooler, MI profile can often be used as the resource to understand each child's area of lesser intelligences where suggestions of bolsters for the weaker areas can be recommended (Gardner, 1999; Metha, 2002). Gardner, (1991) stresses that the profiling of children's strengths or intelligences through close observations enable the teachers understand how children learn best. With the knowledge of students' MI profiles in the classroom, teachers are to prepare and plan lessons which incorporate all the MI with the purpose to cater to students with different learning preferences so that they may benefit from optimum learning (Anderson, 2007; Campbell, Campbell, & Dickinson, 2004). In another word, MI profiles of various children in a classroom do help teachers to promote individualization of each child's learning and nurture their lesser intelligences (Metha, 2002).

In this study; the MI profile (using pictorial MI Diagnostic Tool) for each preschooler was carried out to facilitate the arrangement of various MI groupings (4 to 5 groups) in the selected preschool classroom with each group consists of four (4) to six (6) members. The Diagnostic Tool used for profiling the various MI of preschoolers in the pictorial format has been adopted by Trinity Kids for the past ten years to diagnose or profile the various MI strengths of the preschoolers (refer to Appendix D). Studies have revealed that a pictorial diagnostic tool is more suitable for preschoolers as illustrations serve to describe and portray the meaning of texts far better and more accurately for young children (Carney & Levin, 2002). J. Armstrong (2009) further stresses that teachers' daily observations of the preschoolers in the classroom were taken into consideration to affirm the MI profile of each child. Teachers are reminded that the pictorial MI Diagnostic Tool is a "checklist" and not a test (Armstrong, 2009). The details of MI profiling procedure will be discussed further in section 4.5.3.

2.7.3 Aligning Multiple Intelligences Approach to Teaching Critical Thinking Skills

Many scholars and educators consider CTS (critical thinking skills) as the product of education, training and practice; thus, the learning process should focus on instruction strategies which link CTS to the subject content (Synder & Synder, 2008). While many educators are searching for the best approach for teaching CTS, some scholars suggest that it may be more effective to employ a creative pedagogy such as MI approach for teaching the children to think critically through multifaceted techniques or strategies of MI (Zobisch et al., 2015). Alhamuddin and Bukhori (2016) in their study concurred that MI instruction through a variety of teaching activities, is an appropriate approach for cultivating critical thinking abilities among the learners. The wide variety of teaching strategies allowed learners to response more effectively to activities which are inclined to their strengths and thus enhance the learning and thinking abilities (Deepa, 2014; Nwagu & Nwagu, 2013; Xie & Lin, 2009).

Scholars are also inclined to claim that MIA (Multiple Intelligences Approach) has an education impact on young children's cognitive maturity and development (Delgoshaei & Delavari, 2011; Gardner, 1993). Employing MIA to teaching and learning in the everyday classroom is said to help increase children's learning and thinking as children are allowed to learn and think in many different ways which match their areas of strengths (Kagan, 2000). This implies that children may participate better in critical thinking or problem-solving tasks which are inclined to their areas of MI strengths (Noble, 2004).

A study conducted by Zobisch, Platine and Swanson in 2015, proves that by employing the MI approach as the instruction in an average class has significantly improve the teaching and development of critical thinking skills of its students. Zobisch et al.'s study seems to be in line with the claim made by Howard Gardner (1999, 2000), that the use of multiple intelligences as the approach to teaching helps to promote better understanding and learning of concepts or skills such as thinking skills through providing multiple entry points or multiple representations of the subject, core ideas or skill.

Noble (2004) and Zobisch et al, (2015) further claim that MI theory can be integrated into teaching classes or students of wide range differences with the expectation to reinforce critical thinking skills among the students.

2.8 Application and Transfer of Critical Thinking Skills

Many studies acceded that CTS is non-subject dependent and is therefore transferable across domains provided that the teaching is accompanied by the instruction of "transfer" (Greece, 2002; Halpern, 1998; Halpern, 2014; Royalty, 1995) against the opposing views that not all CTS principles are transferable from one domain to the

(Damitru, 2013; Lai, 2011). Lai (2011); also concludes in her literature review of critical thinking that the transferability of CTS to new problem is more possible or likely to occur within the same domain rather than to a totally different new discipline. This implies that it is more possible for students to apply the acquired CTS in solving new tasks of similar problems nature instead of a new task in a completely different nature. The transferability and application of CTS across curriculum is yet to be affirmed.

However, Lin (2014); through her study findings believes that students who actively practice the CTS that they have learnt are able to apply the skills in different context, different tasks and wider variety of situations. The researcher of this study is supportive of the view that it is possible for acquired critical thinking skills to be transferred to other new situations such as decision making or problem solving.

One of the important goals in education is to promote transfer of knowledge or skills learnt (Collins, 2014; Greece, 2013; Halpern, 2014; Robson, 2012) as the teaching of critical thinking aims to help students understand the skills and to use these skills successfully or appropriately in other novel situations (Halpern, 1998). This is to say that when one learns to think critically, he is interpreting the situation encountered, analyzing the details of information at hand, reasoning out some forms of inferences and evaluating the outcomes of his thoughts or judgements for solving the situations or problems (Facione, 2015; Halpern, 1998; Robson, 2012; Taggart et al., 2005).

Furthermore, Housen (2002) states in his study that CTS can only be taught and developed when there is a subject matter or medium for it to develop and thereafter blossoms to other areas or contexts. Also, in his study Atkinson (1997) claimed that many researchers are in favour of the argument that the visibility of the transfer of CTS can only be possible when there is a development of a better evaluation or operational instrument such as problem-solving tasks or making reasonable arguments as transfer of skills seems to be feasible under specific demand of some tasks.

In general, most of the previous studies stressed on the teaching and the transfer of CTS instead of the application of CTS. However, this study focuses on the application aspect of CTS acquired by young children. Moreover, Lin (2014) concurred with Lipman (1991 & 2003) that "knowing is not equivalent to the ability in thinking" and that in order for someone to be a critical thinker, one needs to practice and apply the critical thinking skills in real life scenarios. No one can simply claim that he or she know how to think critically without applying the skills in settings such as reasoning, decisions making, finding solutions to challenges or problems faced (Halpern, 1998, Housen, 2002). In another word, the outcome of applying the CTS acquired should be evident in the effectiveness of decisions made and how problems are solved (Halpern, 2014).

In conclusion, for young children or preschoolers to understand and to learn the skills of thinking critically, the teacher should specifically provide them a consistent and transparent framework of thinking with authentic real-world learning activities and relevant tasks (such as problems-solving) included, enabling them to become consciously and automatically applying CTS to deal with new situations or challenges they encounter such as to complete new problems-solving tasks and to create solutions for new set of problems (Florea & Hurjui, 2014. Lai, 2011; Robson, 2012).

2.8.1 Critical Thinking and Problem-Solving

The teaching of critical thinking which incorporate problem-solving techniques to students is undeniably most important in preparing them as effective problem solvers and work force for the twenty-first century (Facione, 2007; S Lai, 2011; ynder & Synder, 2008). Zobisch et al. (2015) alleges that to survive in the twenty-first century, one must apply reasoning skills in asking questions, challenge assumptions, connecting knowledge and information to invent new ways of solving problems. Critical thinking is seen as the essential antidote to problems solving for the twenty first century by most scholars (Reece, 2002). Similarly, Synder and Synder (2008) and Halpern (1999) claim that students who have learnt to think critically will most likely be the better thinkers who are able to solve problem more effectively.

Problem-solving is a goal-directed activity (Robson, 2012). Thus, Chi & Shu (2009) suggest that students who are taught and equipped with critical thinking skills are more confident of solving new problems through applying new innovations in the new context without resorting to their old knowledge or experiences.

The two studies conducted in 2000 by Lambert as well as Chen and Siegler (cited in Taggart et al 2005) reveal that problem-solving tasks which are of "open-ended" nature seem to motivate young preschoolers execute their thinking abilities or strategies more spontaneously and skilfully. Lai (2011) on the other hand, proposes that problem-solving tasks which require the exercise of examining information and making judgement tend to draw upon the skills of critical thinking more. For example, in a task which requires children to examine the characteristics of objects provided; identifying which objects would float or sink in water. Thereafter, children are asked to make an inference and a judgement on whether a sponge would float of sink in the water. These children will firstly study and analyse the characteristics of objects which float (as a form of information) and then "thinking more purposefully" to relate the information to the sponge before making an inference on whether the sponge would float or sink when it is placed in the water.

2.9 Past Methodologies in Students' Critical Thinking Skills Research

CTS has long been a popular topic of study for many scholars since decades ago and in recent years the interest of researching and exploring various aspects of CTS has grown even more intense in view of the fact that it is the most crucial skill for the twenty-first century (Collins, 2014; Facione, 2015; Halpern, 2014; Lim, 2011). Based on the review of previous research studies conducted on CTS; a wide variety of methodologies were seen employed by researchers to explore or investigate on the teaching and development as well as assessment of CTS among the young students and adults. These studies included: Delphi method, descriptive or narrative method, experimental design, longitudinal study, action research, review of previous researches, case study, mixed method and naturalist research. These previous studies were reviewed by the researcher as a guide for the design of this present study as per described in Table 2.5.

Table 2.5
Summary of Previous Study Methodologies on Various Aspects of CTS.

No	Researcher	Topic	Methodologies
1.	Peter Facione (1990)	Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction.	• Delphi Method • Discussions
2.	Jane Davis-Seaver (1994)	Critical Thinking in Primary School Children	• Descriptive/Narrative Research • Interviews
3.	Anuradha A. Gokhale (1995)	Collaborative Learning Enhances Critical Thinking	• Quasi Experimental • Pre-Test and Post-Test
4.	Barbara Nicoll (1996)	Developing Minds: Critical Thinking in K-3	• Descriptive/narrative Research • Dialogues with • Primary school children

Table 2.5 *(continued)*

No	***Researcher***	***Topic***	***Methodologies***
5.	Abigail C. Housen (2002)	Aesthetic Thought, Critical Thinking and Transfer	• Longitudinal Study • Observation • Controlled-experimental design
6.	Karen Collier, Tracy Guenther and Cathy Veerman (2004)	Developing critical thinking skills through a variety of instructional strategies	• Action Research • Pre-and-post intervention • Students' journals
7.	Gail D. Heyman (2008)	Children's Critical Thinking When Learning from Others	• Review of various researches on CTS of young children
8.	Charoula Angeli, Nicos Valanides (2008)	Instructional effects on critical thinking: Performance on ill-defined issues	• Control group • three teaching groups (General, Infusion, and Immersion) and the control group. • One-way ANCOVA
9.	Lisa Gueldenzoph Snyder Mark J. Snyder (2008)	Teaching Critical Thinking and Problem-Solving Skills among post-secondary school students	• Review of secondary researches
10.	Einav Aizikovitsh and Miriam Amit (2009)	An innovative model for developing critical thinking skills through mathematical education	• Case Study • Video-recording (transcription)
11.	Einav Aizikovitsh and Miri Amit (2010)	Evaluating an infusion approach to the teaching of critical thinking skills through mathematics in Secondary Schools	• Instructional experiment • ANOVA Test • Pre and Post questionnaire • Personal interviews • Class transcription • Students' products
12.	Joanne Tay-Lim (2011)	Developing Young Children's (Preschool) Critical Thinking Skills through Conversations	• Case Study • Interview (conversation)
13.	Amalina Munirah Bt. Mohamed Zabidi and Nik Suryani Bt. Nik Abd. Rahman (2012)	A Teacher's Experience of Using Critical Thinking in Secondary Classroom Teaching	• Descriptive Research • Observations

Table 2.5 *(continued)*

No	*Researcher*	*Topic*	*Methodologies*
14.	Tammy LaPoint-O'Brien (2013)	Action Research: The Development of Critical Thinking Skills	• Action Research • Minute paper (Notebook)
15.	Sandra Dolores Ruiz Niño (2013)	Working by projects: A way to enrich critical thinking and the writing process in a third grade EFL classroom	• Action Research • Audio recording • Field notes • Artifacts
16.	Heejeong Sophia Han and E. Todd Brown (2013)	Effects of critical thinking intervention for early Childhood teacher candidates	• Mixed Mode • Quantitative: SPSS • Qualitative: Semi-structured interview & documentation
17.	Wong Li Jean, Yeo Kee Jiar (2014)	Critical thinking skills in early years	• Qualitative research (Descriptive • Semi-structured interview, • Observations
18.	Lin Yue (2014)	Infusion of critical thinking into L2 classes: a case study in a Chinese high school	• Case Study • Pretest and Posttest • Questionnaires • Interviews
19.	Jenny Melo (2015)	Strategies to Promote Critical Thinking in the Preschool Classroom	• Naturalistic research (ethnographic study)
20.	Wirawani binti Kamarulzaman and Ismail Sheikh bin Ahmad (2014)	Contributing factors to children's critical thinking ability: The perception of pre-service teachers from a private University in Malaysia	• Case study • Semi-structure interview
21.	Wirawani binti Kamarulzaman (2015)	Affect of play on critical thinking: What are the perceptions of preservice teachers	• Qualitative research (Descriptive Study) • Structured Interview
22.	Paula J. Zobisch and Andree Swanson (2015)	The theory of multiple intelligences and critical thinking among adult students	• Mixed research method: questionnaire and focus group
23.	Firdaus, Ismail Kailani, Md. Nor bin Bakarand Bakry (2015)	Developing Critical thinking skills of students in Mathematics learning	• Quasi experimental • Pretest and posttest • T-test
24.	Herbert Nold (2017)	Using Critical Thinking Teaching Methods to Increase Student Success: An Action Research Project	• Action Research • Questionnaire

Facione (1990) and a team of forty-six experts have taken on the (1) ***Delphi Method*** which was posited as an effective qualitative platform for collecting data and feedbacks from the panel through basically four rounds of discussions to aid in establishing a consensual definition and the set of characteristics for critical thinking skills (Sekayi & Kenndy, 2017). The APA Delphi consensus definition of CTS (Facione, 1990) has since then been used as one the main references for many scholars such as Jane Davis-Seaver (1994), Barbara Nicoll (1996), Angeli and Valanides (2008), Einav Aizikovitsh and Miri Amita (2009), Emily R. Lai (2011), Yue Lin (2014) and Carol Ann Gittens (2015).

Based upon previous studies conducted on the development of CTS, the (2) ***qualitative descriptive or narrative research*** methodologies seemed to be frequently employed by scholars to explore and describe in detailed the development of critical thinking skills among students in the classrooms by means of interpreting and analyzing data collected from interviews and observations (e.g. Amalima Munirah Mohamed Zabidi & Nik Suryani Nik Abdul Rahman. 2012; Davis-Seaver, 1994; Nicoll, 1996; Wirawani Kamarulzaman & Ismail Sheikh Ahmad, 2014; Wirawani Kamarulzaman, 2015; Wong & Yeo, 2014). The nature of this study approach allows the scholars or researchers to describe the development of CTS among the selected participants in an accurate way through careful observations (Clarke, 2005; Merriam, 2009), detailed documentations of all the observations and interviews with the aids of field notes and video or audio recording.

In her study, Davis-Seaver (1994) specifically interviewed and talked to ten selected young children of six to seven years old consecutively over three to four sessions of forty-five minutes to an hour's conversations per session in order to explore and document their critical thinking abilities. The audio-tape recorder was used for all interviews sessions to facilitate the transcriptions of the conversations between Davis-Seaver and the children.

The interviews of teachers (pre-service or in-service) and classroom observations were also widely used as data acquisitions by scholars such as Amalima Munirah Mohamed Zabidi and Nik Suryani Nik Abdul Rahman (2012); Wong and Yeo (2014) and Wirawani Kamarulzaman (2015) for their studies in examining the experiences and perceptions of pre-service teachers on the importance of enabling CTS development among young children. Nicoll (1996) on the other hand, focused on using dialogues with young students to investigate the demonstrations of their critical thinking abilities in explaining their own ideas through the utilization of thinking language. All data collected was then transcribed into rich descriptions of the phenomena studied (Fraenkel, Wallen & Hyun, 2012).

On the other hand, several studies employed the (2) ***experimental design***, another popular research methodology to investigate the influences of learning and instructional approaches on the development of CTS (e.g. Aizikovitsh & Amit, 2010; Angeli & Valanides, 2008; Gokhale, 1995; Firdaus, Ismail Kailani, Md Nor bakar & Bakry, 2015) which involved the applications of specific treatment to selected group(s) against control-group(s) to determine if the specific treatment (independent variable) does influence the outcome (dependent variable) of the investigation (Fraenkel et al., 2012; Creswell, 2014). The experimental design is said to be the most effective way to establish the cause -and-effect relationship between the variables of an investigation (Fraenkel et al., 2012).

Gokhale (1995), employed a pre-test-post-test control-groups of individual learning group (group A) and collaborative learning group (Group B) which have undergone the same treatment of common lectures on the topics relating to "direct circuit" and "parallel direct circuit" of fifty minutes each. Both groups were then given the same worksheets on drill-and-practice with critical thinking items. The post-test with added simple application questions which require extensive thinking were administrated for both groups. Students in group A were given thirty minutes to work on the worksheet individually and referred to the solution-sheets should they encounter problems. Students of Group B, on the other hand were to discuss on how to find solutions and the explain on the decisions made with every member of the group. Each member in the group was given the opportunity to articulate his/her thoughts. The Group B setting promotes "group goals" and "individual accountability" of collaborative learning. An inferential statistical test (t-test) was also employed to indicate the effect of the treatment while data of both pre-test-post-test was analysed through a simple ANCOVA method to maximise validity. The finding of this study revealed a significant correlation that collaborative learning does benefit students in enhancing their critical thinking skills.

In another control group study, Angeli and Valanides (2009) examined the influence of instructional approaches for teaching CTS on students' understanding of CTS. 160 undergraduates were assigned into three treatment groups differing in instructional approaches for the five general CTS: (1) the general-approach group, (2) the infusion-approach group and (3) the immersion approach group as well as one control group. The hypothesis of the study was that 'infusion approach' would be the most effective approach with 'immersion approach' as more effective than 'general approach' while 'control group' being the least effective in inducing critical thinking and thus giving the weakest performance in solving ill-defined issues. Students work in dyad and each group and were taught the five general CTS: (a) analyze the problem, (b) generate solutions, (c) develop the reasoning for each solution, (d) decide which is the best solution, and (e) use criteria to evaluate one's thinking. All the groups were given the same written instruction in tackling an ill-defined issue, "Are American values shaped by the mass media?''. However, unlike the three treatment groups, the 'control group' was not given any videotaped lectures on CTS. In this study, both the control group and 'general approach group' neither have any interaction nor receive any further verbal instruction with regards to problem solving. For the 'infusion approach group', however; students were encouraged to think about CTS and compare with those skills as presented in the video lectures while the students of 'immersion approach group' were guided in their thinking and were given the platform to reflect and evaluate their thinking skills within the real-world issues. Instead of using the inferential statistical test, the California Critical Thinking Skills Test (CCTST) was administered to assess students' CTS performance. Angeli and Valandes (2009) argued that despite the findings supported partially the hypothesis, it was clearly indicated that the appropriate instructional approach does help students to better understand and apply CTS for problem solving including ill-defined issues.

In two other studies, Aizikovitsh and Amita (2009) and Firdaus et al. (2015) both adopted the ***experimental design*** to examine the effectiveness of teaching CTS in Mathematics to secondary school students through the infusion instructional approach. Aizikovitsh and Amita (2009) studied on seventy-one students of fifteen to sixteen years old in a mathematics class using an instructional experiment with fifteen lessons of ninety minutes each over a year and data comprised of students' products, pre-and-post questionnaires, personal interviews, and transcriptions of classroom dialogue. All lessons were 'video-recorded' and all public dialogue was transcribed carefully. At the end of the experimental study, CCTDI test (Critical Thinking Dispositions Test by Facione, 1994) and Cornell tests (Critical Thinking Abilities Test by Ennis, 2005) were administered to confirm the development of CTS of the students.

Firdaus and colleagues (2015), on the other hand; used the quasi-experimental design with pre-and-post-test for the control groups to study a class of grade 12 students non-randomly (Creswell, 2014) selected from a city secondary school and a rural secondary school respectively. This study involved the infusion of CTS into a mathematics learning module with emphasis on problem solving to determine the effect of the infused-mathematics module on students' CTS development. At the end of the module, students were assessed using a self-designed CTS assessment tool to measure their ability to interpret information, analyse information and evaluation of evidence and argument. Both the pre-and-post-test method was used to identify students' CTS before and after the intervention modules. A rubric based on Facione's holistic critical thinking scoring was developed to gauge the level of CTS while an inferential statistical test was used to indicate the significance of student's ability in critical thinking before and after the implementation of the PBL based CTS-infused mathematic learning module.

(4) ***Action research method*** is also seen as another favourite method for scholars who are education professionals (e.g. Aizikovitsh & Amit, 2017; Collier & colleagues, 2004; LaPoint-O'Brien, 2013; Ruiz Nini, 2013) to identify better ways to improve the teaching of CTS in the classroom particularly so when they are personally involved (Fraenkel et al., 2012).

Collier and colleagues (2004) explored the development of young children's CTS through the implementation of a variety of instructional strategies in the classroom. This study was conducted by means of action research method over eighteen weeks through implementing an intervention programme of eleven weeks' well-designed lessons incorporated with genuine problems to teach the curriculum and boost children’s CTS. Numerous developmentally appropriate instructional strategies were employed including environmental enhancements, graphic organizers, journaling, problem-based learning, technology, and questioning techniques at three sites of this study. Students were actively engaged in authentic learning and problem-solving activities with relevant guidance provided by teachers. Data was collected by means of observation checklist, teacher-parent and students’ survey as well as students’ journals. ‘Pre-test’ and ‘post-test’ data on the skills of sorting, recalling, describing, problem solving, predicting and estimating was also collected to gauge students critical thinking abilities. The finding of this study substantiates the essentiality of teaching CTS explicitly through a variety of meaningful and appropriate activities to young children.

Interestingly, in her study; "*Action research: the development of critical thinking skills”,* Tammy LaPoint-O'Brien (2013) also employed the action research method to determine the effect of teachers’ changing or finetuning their teaching approaches (based on students’ needs) in helping twenty-three high-school students understand and develop better critical thinking skills. In this study, Tammy used the “minute paper” (a brief synopsis on three things that students learnt from a lesson: concepts, ideas and perceptions besides posing a question of clarification) to investigate high school students’ CTS development through their ability in articulating their understanding of lessons learnt through writing simple synopsis. The data collection was done in three phases over eight calendar weeks and the results of students’ minute paper writing were recorded and analysed for three consecutive weeks after improvements were made to the teacher’s instructional approach each week.

In addition, Ruiz Nino (2013), the teacher researcher also conducted a qualitative action research to describe the development of critical thinking skills of thirty-six third grade students through project works in English writing lessons. In this study, the researcher repeated the research cycle of planning, acting, observing and reflecting twice. The data was collected in the form of field notes, artifacts and audio recording of project works over eleven learning sessions throughout a period of eight months. Detailed analysis of the study was made based on the data collected and results proposed that project works contributed to the enhancement of emerging CTS of the students concerned.

(5) ***Case Study,*** another popular research design of inquiry in the education field covering in-depth analysis of a phenomenon or process using a variety of data collection procedures (Creswell, 2014) has also been frequently employed by numerous scholars in past to explore and examine the teaching and the development of CTS among different age-groups of students from preschool to universities. Generally, a case study is very much a qualitative mode in nature although it can include quantitative analyses and historical data but unlike experimental research, it does not claim any particular means for data collection or data analysis (Merriam, 2009). This form of research method is often adopted as an investigation of an event; a phenomena, process, issues, or concern in a bounded context (Merriam, 2009) such as the "what" (the choice of case: an event, a process or a phenomenon etc.), "who" (the participants and samplings of study: students, educators, working adults, politicians etc.) and "where" (the site of study: the classroom, institutions, community etc.).

In the study by Aizikovitsh and Amit (2009), they described the investigation they conducted on the development of critical thinking language by incorporating critical thinking skills into fifteen structured mathematics lessons. The mathematics lessons were basically ninety-minutes-lessons on probability infused with CTS and were implemented in the form of an instructional experiment over an academic year. Although data was collected from both qualitative and quantitative resources such as students' products (homework and exam), personal interviews (five students were interviewed at the end of each lesson and a week later), class transcriptions (video-recording of all lessons), teacher's own journal as well as pre-and-post-test questionnaires but all data was purposefully processed in the qualitative mode. A detailed description was provided by the researchers on one particular lesson, entitled "The Aspirin Case" in order to describe the details of the case study process undertaken by them. The analysis of data and the discussion of study were also explained in detailed.

Lim (2011) conducted a single-subject case study in which she explained how the development of CTS in young children can be facilitated through having conversations with adults. There was only one participant in this study, a six-year-old preschool boy with whom the researcher conducted an in-depth "one-to-one interview" designed specifically in the form of an informal conversation. The conversational interview as the main source of data collection was framed in the perspective of "social-constructivist" in view of the collaborative nature of the dialogic engagement between child and adult. In the process of conversational interview, open-ended questionings were employed to allow the child expressed himself based on the topic he suggested. The researcher video-recorded the whole process of interview and data was transcribed, interpreted and analysed using the inductive approach. The findings were presented in the form of a detailed description.

Another similar case study involving in-depth interview of participants (two pre-service preschool teachers) was conducted by Wirawani Kamarulzaman and

Ismail Sheikh Ahmad (2014) to explore the perception of pre-service teachers with regards to factors that contribute to the development of CTS among preschoolers. In this study, the two participants were selected through purposive sampling method to undergo the semi-structured interview for the collection of in-depth information and data. The data was then analysed and transcribed into rich descriptions of the research findings.

Other case study conducted by Lin (2014) appeared to be more complicated than the three case studies mentioned earlier. This single case study design aimed to evaluate the effectiveness of employing infusion approach as a method for teaching CTS in an English Language class where English was students' second language (L2). The researcher of this case study engaged an experimental design with two classes of students from the same high school, one class being given the infusion lessons while the other class, the traditional lessons by the same teacher. In other word, this is a unique case study embedded with experimental design of which data is being collected from various sources including: CCTST and CCTDI (California Critical Thinking Skills Test & California Critical Thinking Disposition Indicators) before and after the intervention stages, self-evaluation questionnaires after certain lessons (e.g. after lessons in week one, four, seven and ten), post-intervention questionnaires and interview (after intervention). The various types of data collected were analysed using the mixed methods comprised of both qualitative and quantitative modes to ensure the reliability and validity of the study. Lin (2014) provided careful and detailed descriptions of the intervention procedure of her study, the process of implementing all the CTS infused English lessons as well as the assessment of her students' CTS level. The case study research methodology of Lin (2014) has shed some light on the research direction for the researcher of this present study in defining the aim and context of her study, which is also an in-depth case study.

2.9.1 Modes of Research on Critical Thinking Skills

Over the years, the variety of research methodologies employed for the study of CTS development or the teaching and assessment of CTS can either be in qualitative or quantitative modes depending on the purpose of the research. For establishing relationships between variables and explaining on the cause-and-effect of those relationships, a researcher often opts for ***quantitative mode of research***. On the other hand, a researcher will choose to take on the ***qualitative mode of research*** if the purpose of the study is to understand a situation or a phenomenon from the perspectives of the participants who may also either be directly or indirectly involved in the study conducted (Fraenkel et al., 2012).

Descriptive research was generally being adopted for describing or narrating the developmental or teaching processes of CTS among the students in the classrooms. On the other hand, ***action research*** serves to identify and establish the effectiveness of certain teaching approaches or programmes which are to be further improved by teachers in order to be more effective for enhancing the CTS development through a few cycles of study.

The ***experimental designs*** in the previous studies were used by the researchers to establish the distinct differences in students' CTS development or abilities between two groups of children (experimental, comparative, treatment or control groups) through a more scientific manner which normally involved interventions or specific treatments. Data collected before and after treatment or intervention is often quantified numerically and analysed through computational methods.

2.9.2 Case Study as the Mode of Research

Case study, in the context of a research method involves an empirical inquiry which allows the researcher of a study to understand and explore a particular phenomenon (Creswell, 2014; Merriam, 2009; Willis, 2014). Merriam (2009) pointed out that it is the unit of analysis which characterises a "case study" and not the topic of investigation. For the study to fit the criteria of a "case", there must be a real phenomenon or a programme (like the teaching and development of CTS) or/and a particular bounded system (a preschool classroom) as the units of analysis which are easily visualised (Merriam, 2009). As such, for the purpose of this case study, the researcher had identified the development of CTS as the phenomena with a selected class of the six-years olds preschoolers at a Trinity Kids centre as the bounded system.

In general, a case study is a qualitative mode of research which includes several elements of storytelling. Thus, the findings of this study are presented in a narrative manner, describing the 'case' which can be understood by the readers through answering the research questions (Creswell, 2014; Gustafsson, 2014).This qualitative approach includes complete data collection, data aggregation, and creating understanding through a descriptive model, providing valid, reliable, and reproducible information (Yin, 2009). The qualitative account of a case study enables the researcher to explain a complex real-life situation (the CTS development among preschoolers) through observations and detailed descriptions which may not be able to be captured by the quantitative research (Zaidah Zainal, 2007). However, as both Merriam (2009) and Shareia (2016) pointed out that a case study can include the quantitative data or analysis to complement the qualitative analysis of the case concerned.

As case study research is an iterative process and thus, data collection and analysis can result in the need for further data collection and even revision of the design of the study (Yin, 2014). Unlike other research methodologies, case study does not claim any form of data collection methods but relies on multiple sources of data, basically from six possible sources such as observations, interviews, audio-visual materials, review of documents, archival records/reports and physical artefacts (Merriam, 2009; Creswell, 2014). For this study, the extensive literature review and identification of pertinent categories based upon current theory facilitated the gathering and analysis of data.

2.9.3 Data Collection Techniques

A wide variety of methods can be employed in collecting the data for a case study whereby these data are conveyed mainly through words (Merriam, 2009). Basically, qualitative data are obtained directly from people's expressions or articulations of their views and opinions through interviews or detailed descriptions of activities through observations (Patton, 2002; cited in Merriam, 2009).

The use of multiple techniques in data collection is a much -preferred method as it enables triangulation of data collected (Kagan, 1990 cited in Loo, 2016). As such, it is deemed to be the most able to capture the complex aspects of teaching and development of CTS in this study as well as to strengthen the internal credibility (validity) of this study (Loo, 2016).

2.9.3.1 Classroom Observations

Classroom observation is one of the main data collection techniques for this study. The classroom observations enabled the researcher to get first-hand encounter with the phenomenon of interest and record information directly instead getting a secondary account as from an interview although interviews are often interwoven with observation (Creswell, 2014. Merriam, 2009).

Undeniably, a good observer is required to pay full attention and be well prepared mentally during the observation process, be systematic in describing data gathered from the field notes and audio-visual recordings, knowing how to separate details from trivia and using various methods to validate observation (Patton, 2002; cited in Merriam, 2009). On contrary, an observer of a case study may be perceived as an intruder if he or she is a total stranger to the participants as in this study, it may raise a concern of affecting the pre-schoolers' behaviour if the researcher lacks good or attentive observation skills.

2.9.3.2 Semi-Structured Interviews and Focus Group Interviews

In most of the qualitative studies, data are mostly collected through 'interviews' or 'purposeful conversation', more so for intensive case studies which involved a few selected participants (Alshenqeeti, 2014; Merriam, 2009). Interviews are important tools used by the researcher to probe what is in the mind of the interviewees or participants of a study (Fraenkel et al., 2014). Through the face-to face or in-person interviews, some data or behaviours which cannot be captured by means of observation can be explained (Creswell, 2014; Merriam, 2009).

A semi-structured interview is known as a less-structured format of interview in which interview questions are more flexible and respondents are guided by open-ended questions focused on the specific data required for the study with no pre-determined wording (Merriam, 2009). Prior to the process of this semi-structured interview, the researchers prepared an interview framework/protocol focusing on central themes and suggested questions without prescribed the content but modify the interview questions as the conversation evolves (Gavora, 2006, cited in Datko, 2015).

On the other hand, using focus group interview involving children is becoming more popular in recent years for qualitative research especially social and education studies (Kutrovátz, 2017). Focus group interview is conducted with a group of individuals (in this case, the preschoolers) who have the knowledge or experience on a particular topic (such as critical thinking), to obtain views or thoughts as a collective perspective from the children simultaneously (Kutrovátz, 2017; Merriam, 2009).

In this case study, two separate focus group interviews were conducted with two selected groups of children respectively. The selected preschoolers were acknowledged as active and competent participants whose voice were sought to express their opinions about issues concerning them (Kutrovátz, 2017). In this study, focus group interviews also served as the triangulation against single interviews of the teachers and principal with regards to their thoughts and feedback on the teaching and development of critical thinking skills in the preschool classroom.

2.9.3.3 Coding and Themes Identification

Generally, in a qualitative research; coding is adopted for identifying the repetitive and consistent patterns of data as well as to analyse these data for obtaining the key concept or factors to describe a phenomenon or a case, as in this study (Gibbs, 2007; Saldana, 2016). According to Yi (2018), the determination of codes can either be inductive (if a researcher builds up the codes from raw data) and deductive (if the researcher already has a general idea of codes in mind). For this study, data collected from various sources such as observation, semi-structured interview and focus group interview which appeared to be consistently or repeatedly highlighted were assembled to form a set of narrative codes.

The categorization of the codes with common points of reference into themes which are used to provide the descriptions of a process, such as the process of CTS development as in this study (Vaismoradi, Jones, Turunen & Snelgrove, 2016). The themes identified are employed to tell and describe a process from different inter-related qualitative perspectives (Yi, 2018).

For the purpose of this study, the themes categorized from the early codes were adopted as a set of data to explain the finding in answering one of the research questions of this study.

2.9.4 Reliability, Validity and Triangulation of Data

As in any qualitative research, reliability and validity of the data collected as well as the inferences and findings derived from these data are an integral process (Creswell, 2012). Qualitative researchers are to ensure the *validity* or *defensibility* of the inferences made from various sources of data collected, being described from the standpoint of the researchers or participants (Creswell, 2012; Merriam, 2009).

In terms of *reliability*, unlike quantitative research; replication of a qualitative research may not provide the same results or outcome, but importantly; the results of study should be *consistent* with the data collected (Creswell, 2012; Merriam, 2009). As recommended by Merriam (2009) and Creswell (2012), among the best strategies to ensure reliability and validity of a qualitative study are the *triangulation* of data sources such as internal validity or credibility which includes peer reviews, external experts' validation and member checks.

Furthermore, in any case study, triangulation (using multiple approaches for collecting and analysing data) plays the role of ensuring the validity of the data collected as well as the reliability of the findings without generalising the findings (Creswell, 2012; Johansson, 2003; Merriam, 2009). For this case study, data was drawn from multiple sources and methods including the quantitative data collected from the assessment of CTS levels of selected preschoolers. Thus, for the purpose of data triangulation, various methods such as classroom observations, interviews and focus group interviews as well as tools such as MI profiling, CTS assessment tools and

ISM infused lessons were utilized as the main sources of data collection. As Merriam (2009) and Creswell advised, triangulation strategy is meant for compensating the limitations of certain data collection methods but exploit the strengths to ensure the congruency of data with reality. For example, the researcher may not be able to observe the thoughts of the preschoolers during the problem-solving tasks execution which she can only find out through the verbal sharing by the preschoolers in the focus group interviews.

The researcher adopted various data collection and data analysis methods in appreciation of the exigency of having multi-methods to capture the more complex aspects of the abstract teaching and development of CTS in the preschool classroom besides deliberately making effort to reduce biasness while purposefully aiming to strengthen the reliability and validity of this study.

2.10 Chapter Summary

This chapter discussed on the various dimensions of critical thinking skills beginning with the definitions, the perspectives and components of CTS. The teaching approaches of CTS aligning with the MI (Multiple Intelligences) theory as well as the application of CTS for problem solving besides looking into the literatures and methodologies of previous studies for identifying and bridging the study gap.

This literature review concluded that it is more effective for critical thinking skills to be taught explicitly to children in their early years. Numerous studies such as those conducted by Kennedy et al. in 1991 and Abrami et al. in 2008; displayed evidence that instructional intervention programmes aimed at developing and improving children's critical thinking skills have generally shown positive impact and desirable outcomes on CTS development (Lai, 2011).

Several past methodologies and data collection techniques employed for studying CTS previously were discussed at the end of this chapter to provide the researcher an insight for the direction of exploring more extensively the teaching and development of CTS among young preschool children in Malaysia. The review of past literatures also provided the references on some of the effective approaches for teaching CTS to enable the transfer of CTS or the application of CTS for real life scenarios such as making choices of decisions and solving problems.

The next chapter explains on the conceptualization of this present study in the perspectives on the teaching and development of CTS among the six-year-old preschoolers as well as the integration of various theories for framing up the theoretical framework for this study.

CHAPTER 3

CONCEPTUALISATION OF STUDY

3.1 Introduction

This present study is focused on the infusion and development of CTS for the preschool children of six years old as well as exploring the pedagogical strategies and approaches in relation to the multiple intelligences approach (MIA) for teaching CTS more effectively at a group of preschools (Trinity Kids) in Malaysia. This study also explored how the CTS can be infused into the lessons of the existing curriculum besides looking into how the acquired critical thinking skills can be applied by students for problem solving tasks and other forms of operations.

This chapter discusses on how the present study is framed with reference to previous studies and literature review for setting the direction of this present study. The conceptual framework of this study is discussed to depict the position of filling in the gaps through exploring the development of CTS among the young preschoolers in the classroom. The definition of CTS and the employment of MI approach for teaching the CTS infused lessons are drawn up with reference to past literatures. The main theory that underpins this study, the theory of Multiple Intelligences, founded by Howard Gardner (1983.1993, 1998, 1999) is also discussed as the theoretical framework in support of this study. The "Infusion Approach" by Swartz and Parks (1994) is discussed for its involvement in drawing up the infused lessons. The roles of learning theories of "cognitive constructivism" by Piaget and "social constructivism" by Vygotsky are also discussed in the theoretical framework of this study.

3.2 Previous Studies Related to Critical Thinking Skills

Many studies in the past have discussed and concurred that critical thinking skills are the imperative competency required for the 21st century which can be taught to students explicitly as early as during their preschools stage of education (Aizikovitsh, 2010; Bellanca, 2014; McGuiness, 1999).

As summarized in table 3.1, most of the previous studies discussed on the need for developing CTS among older learners who lacked the skills to solve problems as per reported by PISA and TIMSS (Azian T. S. Abdullah, Muhammad Zaini Mohd Zain, Sheela G. Nair, Rusliza Abdullah & Ihsan Ismail, 2016; Kang, 2013; Leong, 2013; Zul Fikri Zair & Anas Alam Faizli, 2013). With hindsight of the need to teach CTS, some studies explored on the effective strategies (Aubrey et al., 2012; Birbili, 2013; Collier et al., 2004; Melo, 2015), assessments and application of acquired CTS (Houston, 2002; Ku, 2009). Numerous studies identified the favourable approach for teaching CTS through infused curriculum (Aizikovitsh Amit, 2009; Firdaus, Ismail Kailami, Md Nor Bakar & Bakri, 2015; Lin, 2014) while MI based teaching was recommended by Zobisch et al (2015) as an effective pedagogy. Although some studies claimed possibility and necessity of teaching CTS in the early years (Davis-Seaver, 1994; Nicoll, 1998; Wirawani Kamarulzaman & Ismail Sheikh Ahmad, 2014; Wong & Yeo, 2014) but they have yet to provide recommendations on approaches and strategies for teaching CTS to young children.

This present study proposed a notion on the need to teach CTS to preschoolers through an infused curriculum employing the teaching approach basing on MI theory. This study can be novel in the attempt of preparing ISM as the complementary set of teaching material for an intervention purpose as well as the assessment tool for evaluating the CTS level of Malaysian preschoolers.

Table 3.1
Previous Studies on Issues Concerning CTS

Issues	***Articles***	***Author/year***	***Remarks***
PISA and TIMSS results: Reflection on critical thinking ability of Malaysian students	Poor show in Pisa rankings	Kang Soon Chen (2013)	Higher Order Thinking (HOT) is one of the main elements of PISA, Malaysian students generally lack HOT as Malaysia's education is too exam-oriented focusing on testing students' memory
	TIMSS 2011: An analysis of Malaysia's achievement	Zul Fikri Zamir and Anas Alam Faizli (2013)	TIMSS and PISA evaluates levels of literacy, reading skills and critical problem-solving as opposed to memorization skills. The low ranking indicates a lack in these skills.
	The Malaysian Education Blueprint: balancing policy and practice	Hugh John Leong (2013)	Poor performance of Malaysian students in PISA 2012 reflected that students were not able to demonstrate HOT or CTS in thinking and drawing connections to solve real-life related problems.
	PISA: Malaysia's wake up call for a more balanced approach to educational delivery and attainment	Azian T. S. Abdullah, Muhammad Zaini Mohd Zain, Sheela G. Nair, Rusliza Abdullah and Ihsan Ismail (2016)	PISA assessment focused on the mastery of three main skills for 21st century: communication, CT and problem solving whereby CTS is most lacking in Malaysian students among the five Southeast Asia countries
Critical Thinking Skills (CTS) abilities or potential in young children	Critical thinking (CT) in Primary School children	Jane Davis-Seaver (1994)	Investigation on whether or not young primary school children can think critically
	Developing CT in K-3 / Primary School.	Barbara Nicoll (1996).	Teaching CTS to K3 (6 years old-Primary children) – through modelling of thinking disposition
	CTS in early years	Wong Li Jean, Yeo Kee Jiar (2014)	Explore the early-years teachers' ideas on the teaching of critical and creative thinking skills among young children
	Contributing factors to children's CT ability: the perception of pre-service teachers from a private university in Malaysia.	Wirawani Kamarulzaman and Ismail Sheikh Ahmad (2014)	The perceptions of pre-service early childhood education teachers on the factors that contribute to CT ability of children

Table 3.1 *(continued)*

Issues	***Articles***	***Author/year***	***Remarks***
Effective Programmes or Strategies for developing and enhancing CTS	Enhancing thinking skills in early childhood through thinking skills programmes	Carol Aubrey, Kathryn Ghent and Eleni Kanira (2012)	Investigating the effect of 2 "Thinking Skills Programmes" on the thinking skills development for children of 5 & 6 years old
	Developing CTS through a variety of instructional strategies	Karen Collier, Tracy Guenther and Cathy Veerman (2004)	Developing primary school students' CTS by implementing a variety of instructional strategies such as graphic organizers, journaling, problem-based learning and questioning techniques.
	Developing young children's thinking skills in Greek early childhood classrooms: curriculum & practice	Maria Birbili (2013)	Explore how Greek early childhood teachers promote the development of thinking skills in their pupils through effective pedagogical strategies.
	Strategies to Promote CT in the Preschool Classroom	Jenny Melo (2015)	The beliefs of preschool teachers in promoting & developing CT in their classrooms using appropriate strategies
Infusion approach for teaching CTS	An innovative model for developing CTS through mathematical education	Einav Aizikovitsh and Miriam Amit (2009)	The development of language of CTS through infusion or incorporation of CTS into the structured mathematics lessons
	Infusion of CT into L2 classes: a case study in a Chinese high school	Lin Yue (2014)	The effectiveness of teaching CTS through the infusion approach in two L2 classrooms of a high school.
	Developing CTS of students in Mathematics learning	Firdaus, Ismail Kailani, Md. Nor bin Bakar and Bakry (2015)	The effectiveness of teaching CTS through PBL (Problem-Based Learning) method for Mathematics Lessons which are infused with the core cognitive skills of CTS.
Assessing CTS and the transfer of CTS	Aesthetic Thought, CT and Transfer	Abigail c. Housen (2002)	Hypothesis testing of a transfer of CTS through a longitudinal project with primary school students of two schools.

Table 3.1 *(continued)*

Issues	***Articles***	***Author/year***	***Remarks***
	Assessing students' CT performance: Urging for measurements using multi-response format	Kelly Y.L. Ku (2009)	Discussion on the ambiguities in CT assessment through reviewing the components of CT and the compatibility of the commonly used CT tests.
MI theory and teaching of CTS	The theory of multiple intelligences (MI) and CT among adult students	Paula J. Zobisch and Andree Swanson (2015)	The use of teaching techniques based on MI theory can help increase adult students' CTS

3.3 Filling the Literature Gaps

Living in the era of overflowing information and rising challenges, one is required to be equipped with the skills to challenge the validity of information, connect new knowledge to previous experiences, apply ideas to new situations and create new ways to solve problems. In short, one needs to have critical thinking skills and certainly the general consent is that the development of such skills should begin during the early years of education (Taggart et al., 2005).

As reported in OECD (2014), the PISA assessment emphasises on problem solving processes which involve: (1) the exploring and understanding of all information related to the problem situation; (2) representing and formulating relevant factors and the relationship between them; (3) planning and executing by devising strategies and implement ways to solve problems; (4) monitoring and reflecting which involves evaluating the strategies or solutions adopted to ruminate the effectiveness. These four cognitive skills are closely related to the six core cognitive skills of critical thinking defined by APA Delphi Report (Facione 1990): interpretation, analysis, inference, evaluation, explanation and self-regulation. In short, the problem-solving processes of PISA require critical thinking skills. Literature review shows that when Malaysian secondary school students lack critical thinking skills, they are not able to think in order to solve those problems which are related to real life issues in the PISA assessment and therefore fared badly in PISA (Vasagar, 2014). This implies that there's a need to teach CTS to children at a much younger age. (Refer to Table 3.2 for literature gap 1.)

Just like many educators and scholars worldwide, in view of the importance of critical thinking in preparing the productive future human capital, Malaysian early childhood educators are proponents of including the teaching of CTS in the preschool curriculum. However, such emphasis is not prominently evident in the latest national preschool standard-based curriculum or NPSC (Wirawani, 2014). Preschool educators particularly, wish to advocate for the emphasis on the inclusion of CTS teaching and development in the preschool education setting to allow young children learn and develop the skills of critical thinking during their early years of growth and development. (Refer to Table 3.2 for literature gap 2.)

Although numerous studies have explored ways and means to teach CTS explicitly to the students more effectively through various tested approaches particularly through the infusion approach (McGuiness, 2000; Padget, 2014; Swartz & Parks, 1994). However. there is still no consensus for teachers on how to teach CTS. Besides, there is insufficient support provided to help teachers teach CTS to the preschool students in particularly. For Malaysian preschool teachers to teach CTS which is not mandatory in the preschool teaching and learning, the provision of instructional materials would be an enhancing support for the teachers. (Refer to Table 3.2 for literature gap 3.)

Table 3.2 and figure 3.1 (in the following page) show the literature gaps and how the researcher has tried to investigate those gaps through setting the research objectives and research questions of this present study.

Table 3.2
Closing the Literature Gaps

Literature Gap	Closing the Gap
1. Teaching and development of CTS should begin as early as in the preschool education.	To examine the level of CTS among the young children in the preschool setting.
2. There is no emphasis for teaching and development of CTS in the general preschool curriculum.	To prepare and implement intervention programmes infused with CTS to be used as the instructional support materials which are MI activities based.
3. There is no consensus on how teachers should teach CTS or how they can help preschoolers develop CTS.	To explore the appropriate approaches for teaching CTS as well as to describe the development of CTS among the preschoolers.

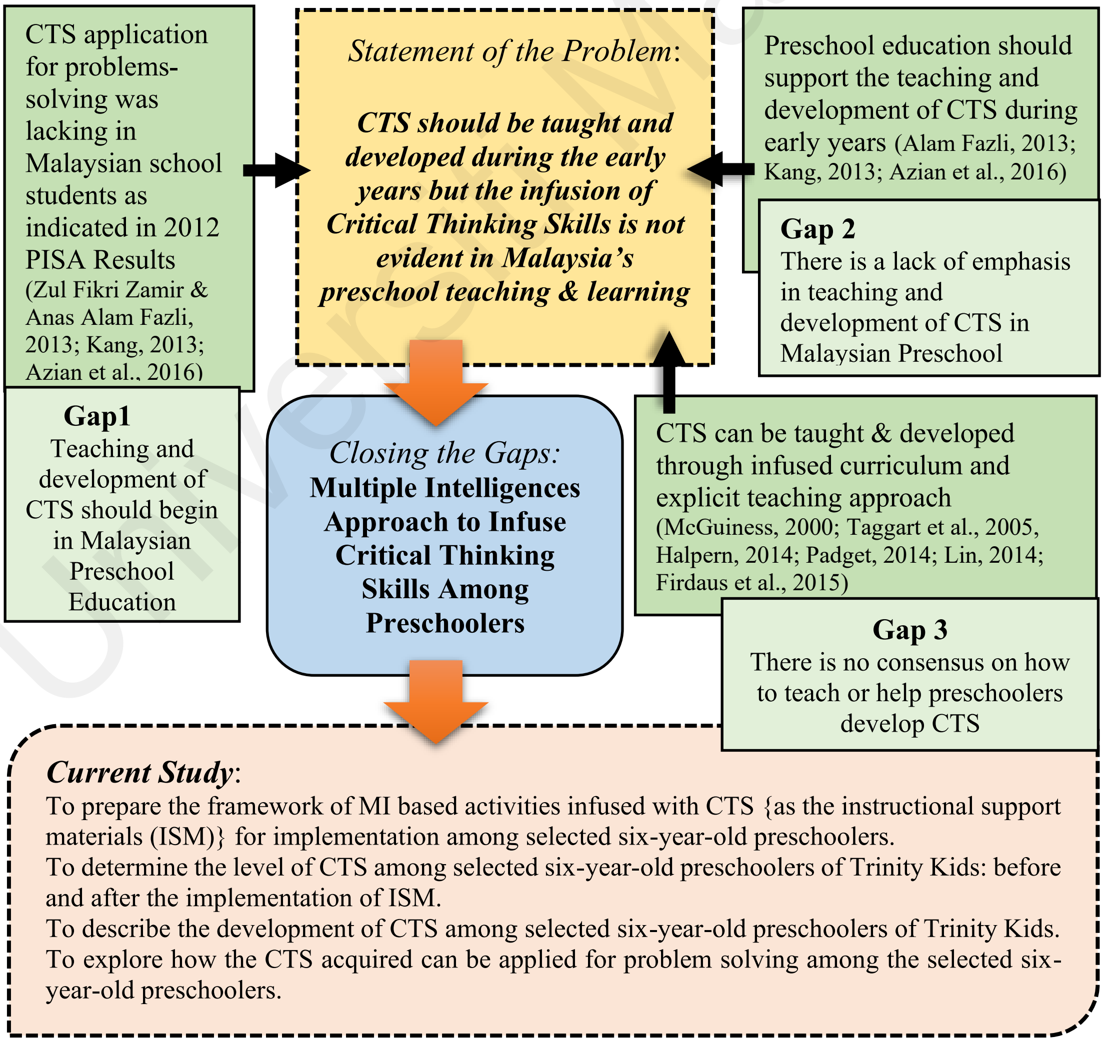


Figure 3.1 Research gaps of this present study

3.4 Conceptual framework of This Study

This basic conceptual framework for this present study discussed here in this chapter is framed against numerous past studies and discussions on the concerns and issues related to the teaching and development of CTS as well as the application and assessment of acquired CTS (Table 3.1) which helped to identify the three gaps for this present study.

The analysis of the PISA (Programme for International Student Assessment) results in 2012 by OECD (Organisation for Economic Cooperation and Development) reflected that Malaysian students fared poorly in the assessment due to the lack of ability in applying CTS for solving real-life related problems in mathematics and science (Kang, 2013; Salihuddin Md Suhadi, Norasykin Md Zaid, Hasnah Mohamed, Zaleha Abdullah & Baharuddin Aris, 2014.) This served as a wake-up call for Malaysia's Ministry of Education to review its education goals and focus which are known to be exam-oriented focusing on testing students' memory of information rather than application of the skills acquired for dealing with everyday real-life issues (Azian et al., 2016; Kang, 2013).

The review of past literature shows that the teaching of CTS is more prominent in the secondary schools, colleges and universities. The researcher of this study argues that, just like other foundational literacies such as reading, writing and counting; CTS should be taught to children during their preschool years. This leads to the identification of the first gap (Figure 3.1): teaching of CTS should be made explicit in the Malaysian schools and that it should begin in preschool (Wirawani Kamarulzaman & Ismail Sheikh Ahamd, 2014) to provide a head-start opportunity for the young people to acquire and develop CTS at an early stage (OECD, 2012).

In addition, numerous studies by thinking experts of early childhood education stressed that preschool education should notably support the teaching and development of CTS during early years with the aim to enable preschoolers apply the CTS that they have learnt through dealing with daily issues encountered or solving daily problems and challenges outside the classroom (Abigail, 2002; Birbili, 2013; Lai, 2011; Reece, 2002; Wirawani Kamarulzaman & Ismail Sheikh Ahmad, 2014; Wong & Yeo, 2014).

Although the revised Malaysia's National Preschool Standard-Based Curriculum (NPSC, 2017) framework places more emphasis on the development of twenty-first century skills especially HOT (higher order thinking) which includes both the critical and creative thinking skills. However, the researcher of this present study argues that there is no prominent evidence of the emphasis on teaching and development of CTS in the current curriculum document. As suggested by numerous thinking experts, the explicit teaching of CTS for the preschools should be made mandatory in the revised curriculum document tor guidelines instead of implicitly mentioned in the curriculum document (Birbili, 2013).

To ensure that CTS is made mandatory, the NPSC should distinctively indicate that the ability to think critically be included as one of the learning outcomes planned for each lesson. Just like the language skills, the skills for critical thinking should be listed among the 'content standard' and the 'learning standard' of each of the six learning strands. This issue is labeled as the second Gap (Figure 3.1).

Below is the example of the proposed guidelines for an English Language lesson (pg. 32 of NPSC) with the suggested an add-on learning standard (1.1.4) to reflect the mandatory teaching of CTS through including the additional learning standard for CTS (BI 1.1.4) explicitly as in table 3.3:

Table 3.3
Proposed Lesson Plan Guidelines with CTS Included (as highlighted in BI.1.1.4)

Content Standard	Learning Standard	
	4+ (five years old)	5+ (six years old)
BI 1.0 LISTENING AND SPEAKING SKILLS		
BI 1.1 Listen to and identify sounds	Pupils can: **BI** 1.1.1 Listen to and identify common sounds in the environment	Pupils can: **BI** 1.1.2 Listen to and respond to stimulus given: (i) Environmental sounds (ii) Voice sounds (iii) Rhythm and Rhymes (iv) Alliteration **BI** 1.1.3 Listen to and identify rhymes in nursey rhymes and songs (Note: NPSC should add on a learning standard which reflect CTS explicitly to ensure the teaching of CTS): **BI** 1.1.4 To listen to and ***analyse*** the different environmental sounds and voice sounds

Note: An excerpt from NPSC 2017 (page 32). (BI = English Language – originally there are only three learning standards provided as teaching guidelines for the six years old: BI 1.1.1-BI 1.1.3. The researcher proposed to add on one extra learning standard, BI 1.1.4 to enable the explicit teaching of CTS.)

Besides, previous literature suggests that CTS can be better taught explicitly through infused curriculum by integrating cognitive skills of critical thinking and knowledge within the themes or topics of the existing curriculum and the daily teaching activities which captivate young children's interest through employing appropriate teaching approaches (Firdaus et al., 2015; Lin, 2014; McGuiness, 1999; Padget 2013; Taggart et al, 2005). Through their extensive literature review on thinking skills for young children, Taggart et al. (2005, cited in Birbili, 2013) pointed out that appropriate activities to be infused into the daily lessons for the purpose of developing young children's CTS should be those activities which promote children's persistency in problem solving, engaging classroom events which challenge or stimulate children's thinking as well as activities which cause children to reflect and evaluate their choice of decisions.

Ridley (2005) in his review of the literatures, concurred that “infusion approach” which incorporates (critical) thinking skills into the day-to-day teaching and learning activities enhances the development of (critical) thinking skills across curriculum (Audrey et al., 2012; Birbili, 2013). Despite the concurrence on the adoption of infused curriculum by many scholars, the researcher of this study deliberates that there is no clear consensus in the pedagogical context provided for the preschool teachers concerning how to teach or help children or preschoolers develop CTS in the preschool classroom. This concern gives rise to the third gap of this present study (Figure 3.1).

For the purpose of closing these three gaps deliberated above, this present study was framed on the basis to establish the claim that CTS should be taught to children as early as during the preschool education years. The skills of critical thinking were taught explicitly through the infusing the four selected core cognitive skills (interpretation, analysis, inference and evaluation) into the daily teaching and learning activities of the existing preschool curriculum stipulated for the six years old. The pedagogical support which is based on the theory of MI (Multiple Intelligences) was employed to allow the teaching of CTS infused lessons (as in the set of instructional support materials) in a more effective manner. Employing MI based approach to teaching involves the use of multiple modalities of teaching and learning which aimed to address the various different learning preferences or strengths of the children (Zobisch et al., 2015).

The overview of the conceptual framework for this exploratory case study is illustrated as in Figure 3.2 in the following page:

CONCEPTUAL FRAMEWORK

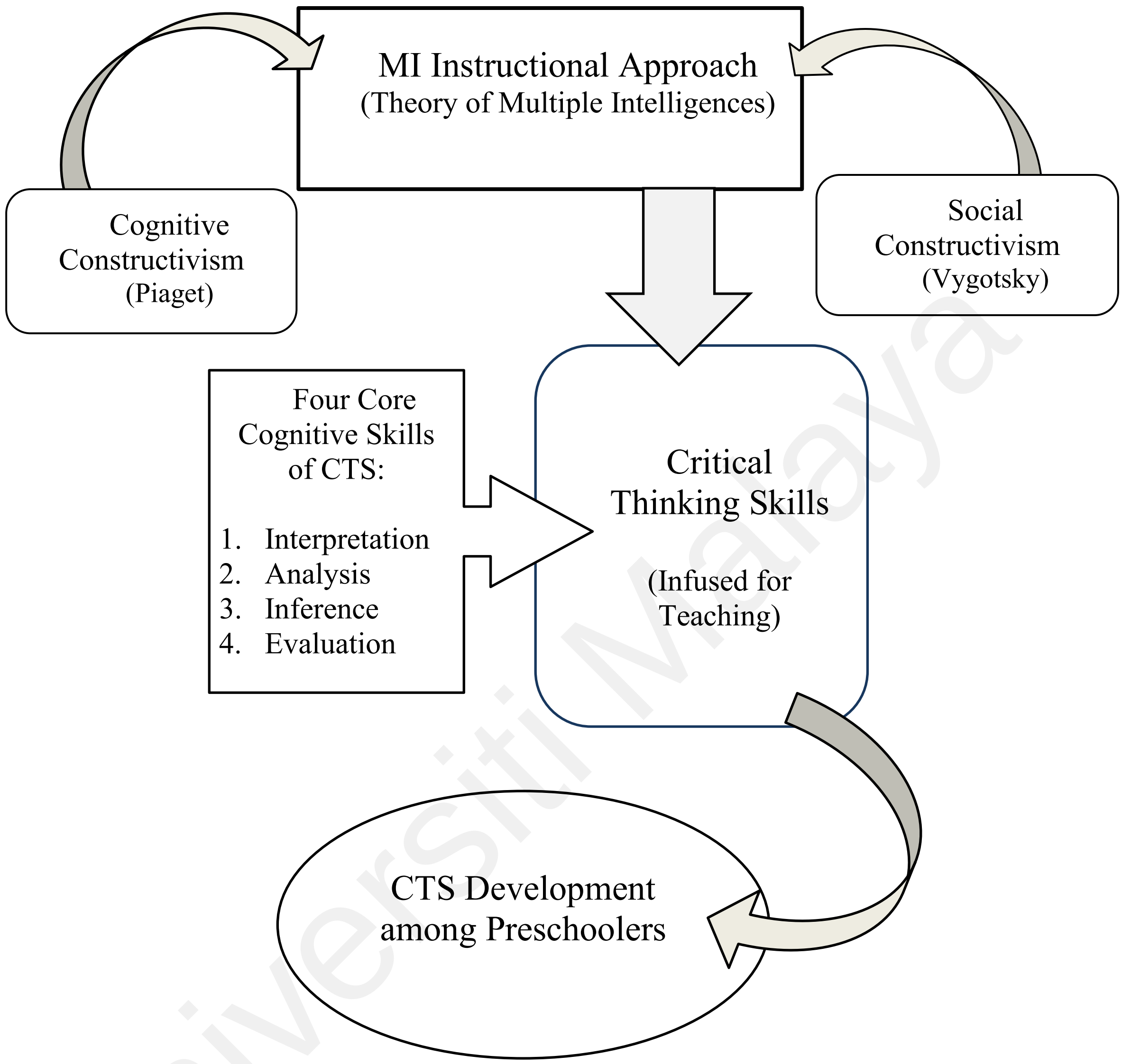


Figure 3.2 Conceptual Framework of this case study

3.5 Infusion Approach Framework of Swartz and Parks

The teaching of critical thinking skills in the context of schools (secondary and elementary) is often associated with the framework of infusion approach described by Swartz and Parks (1994) as in their book "Infusing the Teaching of Critical and Creative Thinking into Content Instruction". In addition, McGuiness (1999), Robson

(2012) and Dowling (2013) advocated for Swartz and Parks' infusion approach as an effective approach for teaching CTS to young children.

Swartz and Parks (1994), stated that there are two main instructions which are believed to be effective in teaching thinking skills: (1) direct instruction in non-curricular contents (the teaching of thinking skills) and (2) employing methods to promote thinking skills within the curricular contents (developing the skills of thinking). They then proposed for a combination of both the instructions by infusing thinking skills into curricular contents (Lai, 2011) whereby the *explicit teaching* of thinking skills is *integrated* into content relevant lessons and both the thinking skills and lesson contents are taught or learnt concurrently (Perkins & Swartz, 1991; Swartz, 1994; Swartz & McGuinness, 2014). Swartz's infusion approach advocates for the thinking skills to be integrated into the existing curricular subject contents, thus allows thinking skills to be taught explicitly through structured lessons for various subjects and students can learn skilful thinking explicitly in the regular classrooms (McGuinness, 2005; Perkins & Swartz, 1991; Swartz & McGuinness, 2014). In this expect, students are taught the skills of thinking skilfully or critically and in return apply the critical thinking skills to think about the learning contents of other lessons taught with deeper understanding and reflection (Swartz & McGuinness, 2014).

The infusion approach serves as a mean to provide direct and explicit attention to the teaching of critical thinking skills within the preschool curriculum subjects where development of thinking skills permeates throughout a broader range of content learning with much more depth while encouraging problem-solving for young children to experience and apply thinking practices (Perkins & Swartz, 1992; Robson, 2012; Swartz & Parks, 1994; Taggart et al., 2005).

In the preschool setting, studies reveal that the infusion approach for integrating thinking skills and knowledge within the existing early years curricular themes or topics are likely to be the more developmentally appropriate pedagogical approach for teaching thinking skills to pre-schoolers (Davis-Seaver, 2000; Robson, 2012; Taggart et al., 2005). The infusion model allows preschool teachers to consistently or systematically identifying opportunities within the existing normal curriculum for teaching specific skills such as critical thinking skills per se (McGuinness, 1999). McGuinness, Eakin, Curry and Sheehy (2007) further concurred that the infusion model allows young children develop their thinking abilities through recognising common or specific patterns of thinking to help them understand deeper and make connections between the subject contents they learnt.

In consideration of the issue on “teaching for transfer” or “teaching for application”, educators and teachers incline more towards the infusion approach as the thinking instruction; a coherent instruction that seems to bridge the learning of subject contents with learning the skills to think critically across lessons infused with critical thinking (McGuiness & Swartz, 2014).

In the perspective of this study, the explicit teaching of CTS was integrated into the current curriculum lesson contents of a six-year-old preschool class coupled with direct instruction being applied by the class teacher to specifically teach students think critically. Existing lessons prescribed by the preschool curriculum were restructured to include various core cognitive skills of critical thinking identified as the main learning goals or leaning outcomes for the implementation of the daily lessons in the class. The infusion approach to teaching thinking skills can be illustrated as below:

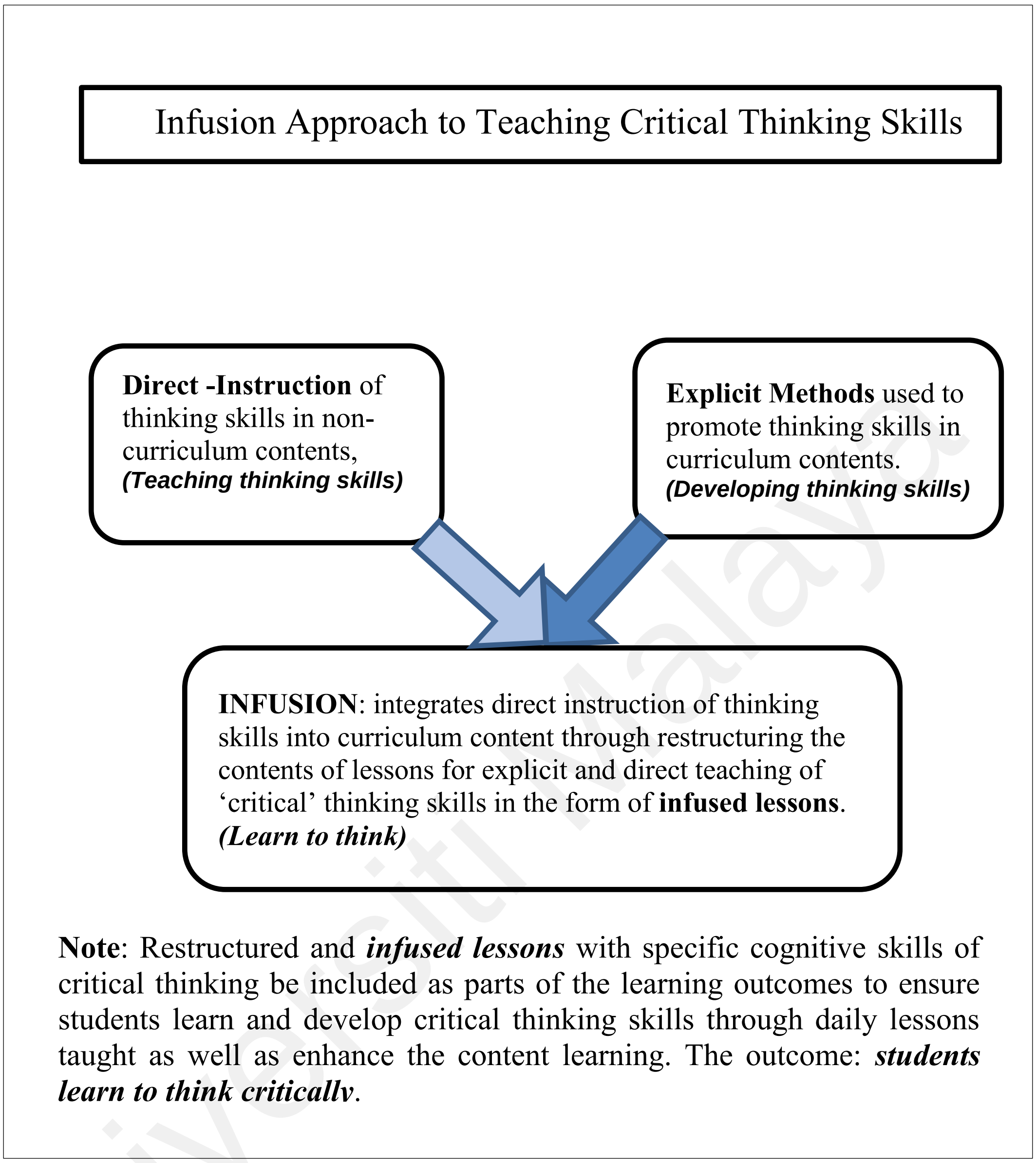


Figure 3.3 Infusion Approach from Swartz and Parks (1994)

3.5.1 Infusing Critical Thinking Skills into Preschool Curriculum

Despite the constrain or limitation of their experiences, young children are said to be engaged in critical thinking when they use their reasoning skills to analyse or interpret the lesson contents taught in the classroom to justify the meaning and truth as well as to make choices, decisions or creating solutions for issues which they encounter inside or outside the classrooms everyday (Dowling, 2013; Educate Insight, 2018; McGuiness, 1999; Robson, 2012). While children are taught academic knowledge through various subject contents learning prescribed in the curriculum, they ought to be taught to reason about the elements and information of the contents learnt, figuring out to understand (*interpret and analyse*) the meaning of the contents; to draw conclusions or assumptions (*inferences*) about the contents and to assess (*evaluate*) the claims made in the content (Educate Insight, 2018). This assumption further implied that teaching CTS to young children can be done more effectively through the inclusion of CTS into the teaching of the subject contents in the form of daily lessons in the preschool classrooms.

Under the infusion approach, there is no pre-structured set of detailed lesson plans but an explicit method to be adapted to the developmental needs and the preschool national curriculum requirement (Davis-Seaver, 2000; Taggart et al., 2005). Teachers are to design daily lessons in accordance to the existing curriculum content infused or embeded with one or various critical thinking skills such as analysis or interpretation (Bellanca, 2014) basically in the form of teaching or learning materials (Aizikovitsh & Amit, 2010; Swartz & McGuiness, 2014).

It is important to note that, through infusion approach, the teaching and learning of curricular content and critical thinking goes hand-in-hand where teaching of lesson contents and training students to think critically form the main foci of lesson planning for the teachers (Sedaghat & Rahmani, 2011; Swartz & Parks, 1994). In other words, these infused lessons are designed to contextualize thinking skills within a curricular area in order to pursue the development of thinking skills as well as achieving the goals of content understanding among students simultaneously (McGuiness, 1999, McGuiness, 2005; Mohamad Ahmad Assaf, 2009).

Often, in the preschool setting, one area of consideration for the teaching of CTS is to be conscious of the issue of developmentally appropriateness (Nicoll, 1996). In cognizant of ensuring developmental appropriateness, the curriculum, contents of learning, activities, environment and the pedagogy are expected to be in accordance or matching to young children's emerging level of mental ability as well as stages of development in order to promote optimum development of thinking and learning (Elkind, 1988; Nicoll, 1996; NAEYC, 2009). Although early scholars like Piaget (1930) suggested that logical reasoning or critical thinking only begin to develop during the adolescence stage; in contrast many recent scholars argue otherwise that logical thinking is gradually developing throughout infancy and early childhood (Whittaker, 2014). The latest studies substantiate the fact that children as young as three to five (3-5) years old are developmentally capable of consolidating and extending schemes of more complex thinking to understand, reason and analyse problems as well as to draw solutions based on their experiences (Dowling, 2013; Lai, 2011; Whitaker, 2014; Wirawani Kamarulzaman, 2014).

Many recent studies further substantiate factually that children of five to seven (5-7) years old (who at the later phrase of Piaget's preoperational developmental stage) experience a "shift in development" of the critical thinking ability where they display better understanding and interpretation of issues, construct informal inferences for solving problems and justify the choice of decisions made or suggest alternatives (Anthony, 2017; Dowling, 2013). Dowling (2013) observes that children at this age group began to use thinking language such as "I think, I guess, I know, I remember" to explain their thoughts. This implies that at five or six years old, children are capable of interpreting issues or problems, analysing the information or data provided, constructing simple inferences to solve the issue and justifying their choice of decisions.

Carol Gittens (2017), an expert in children's CTS, working alongside with Peter Facione, informed that Insight-Assessment (responsible for developing the CCTST- California Critical Thinking Skills Test) has developed the CCTST for K2, the preschool level which was released in late September 2017 (personal communication, 23rd August 2017). According to Gittens (2017), through the years of continuous research with "Insight-Assessment" and in the process of developing the K2- CCTST (reasoning skills test); five core cognitive skills in accordance with APA Consensual Definition of Critical Thinking (Facione, 1990), have been identified as "developmentally" appropriate for K2 (six-year-old) children: *interpretation, analysis, inference, evaluation* and *explanation* (personal communication, 30th August 2017) in the context of how they can be operationalized and measured (personal communication, 7 April 2018).

On the other hand, Nicoll (1996); in her study, suggested to consider the *interpretation*, *analysis*, *inference* and ***explanation*** as the four core-cognitive and sub-skills (such as categorization, decoding, clarifying meaning, examining ideas, conjecturing alternatives, drawing conclusions, stating results and justifying) of critical thinking for young children. These four core cognitive skills are considered to be developmentally appropriate for young children of five or six-years-olds. The study further suggested that these four core skills be included in the early childhood curriculum as illustrated in Table 3.4 in the following page.

Table 3.4
Nicoll (1996): Proposed CTS (Developmentally Appropriate) to be Included in the Early Childhood Curriculum

Core Skills	Sub-Skills
Interpretation	• Categorizing (putting objects/ideas into groups) • Decoding (figuring out what symbols mean) • Clarifying meaning (understanding/describing ideas)
Analysis	• Examining ideas (determining/wondering about ideas)
Inference	• Conjecturing alternatives (using what ifs) • Drawing conclusions (making decisions/ possibilities)
Explanation	• Stating results (describing observation) • Justifying (giving reasons)

Note: Core Skills of CTS based on APA Consensual Definition

However, in the context of Malaysian preschool setting and with refence to the continuous research of 'Insight Assessment', the researcher of this study proposed to focus on these four of the cognitive skills, namely: interpretation, analysis, inference and evaluation (instead of explanation). As in Malaysia, English is the second language for the young students and thus "*explanation*" may better be considered as the focus for the next level of development. Gittens (2017) acceded to this assumption and proposal in a few email correspondences (personal communication, 29th & 30th September 2017).

Adapting from the constructs of the K2-CCTST framework developed by Insight Assessment (2017) and the assessment tool for assessing the CTS of K2 children (six years old), the researcher of this present study drew up the content of the CTS teaching materials with general tasks designed based on the constructs of CTS core skills as illustrated in Table 3.5 (in the following page).

Table 3.5

Model for Teaching CTS Lesson Planning Based on the Framework of K2-CCTST

CTS	*Constructs*	*General Tasks*	*Prompting Questions*
Interpretation	The skill to describe what children think something means in a given context through determining and assigning meaning of information. It can be applied across many contexts such as written instructions; visual diagrams, charts, graphs or graphics; social interactions or behaviours and events.	1. Understand and explain the meaning of the information, events, symbols, diagrams instructions or questions. 2. Classify and categorize the given data or information into various groups or categories. 3. Discuss and describe the meaning of the visuals, instructions or questions.	1. What does this mean? 2. What is happening? 3. Do you understand what is the meaning or requirement here? 4. What did they say or do? 5. Can you classify or categorise these items?
Analysis	The skills to identify and detect the details and patterns of the provided set of reasons, assumptions, themes and evidence for making arguments or explanations. It enables children to examine all the key elements of information gathered from spoken language; written document; visuals such as charts, graphs, diagrams; to relate them and consider their relevancy in any given situation.	1. Identify and explain the characteristics or details of the information given. 2. Describe the patterns and characteristics detected from the given information 3. Examine the details of information and provide the reason for the choice of decision or the relevancy for a particular situation.	1. What have you observed? 2. What are your reasons for saying this? 3. Why do you think/ say so? 4. What are the similar patterns/ characteristics? 5. What are the pros and cons? 6. Are they relevance?
Inference	The skill to predict likely possibilities or logical consequences from the reasons, evidence, observations, or own experiences and beliefs in order to draw reliable conclusions. It enables children to make accurate assumptions through information provided using various forms of logical, analogical, probabilistic, empirical and mathematical reasoning.	1. Review observations or evidence given and suggest likely possibilities or consequences. 2. Discuss on the reasons and answer the questions of "what if". 3. Provide logical assumptions or conclusions based on the details of the given situations or questions.	1. What are some of the possibilities? 2. What does the evidence tell us? 3. What if we choose the other way or idea? 4. What did you observe? 5. How many ways can this be solved? 6. What other alternatives can we have?

Table 3.5 *(continued)*

CTS	*Constructs*	*General Tasks*	*Prompting Questions*
Evaluation	The skill to assess the credibility of claims and arguments made by others through judging the acceptability of the elements and facts in the context of their interpretation, analysis, options, explanation, opinions, hypothesis, proposals and decisions. It enables children to judge the quality and reliability of the arguments and claims in terms of factual and truth.	1. Examine and check the accuracy of the interpretation of the data and information given. 2. Discuss and justify the reasons of accepting certain facts or claims. 3. Review and state the credibility of the answers given or conclusions drawn.	1. How true do you think is the information? 2. Should this answer be accepted? 3. Do we have the facts right? 4. Can we justify the answer? 5. Can we confirm the accuracy of the answers? 6. Are we confident with our conclusions?

Note: Constructs of the core cognitive skills of CTS taken from K2_CCTST

3.5.2 Infused Lessons for Teaching CTS in the Context of Malaysian Preschool Curriculum

According to Swartz (1991), infused lessons involve complex restructuring of the exiting lesson contents by using variety of techniques to blend the learning of thinking skills with subject content learning. Swartz, Kiser and Reagan (1999), in their book further elaborate that good restructured infused lessons should consist of clear explicit strategies for teaching thinking skills, collaborative thinking activities for students, metacognitive reflection on thinking skills applied and practices of transferring thinking skills for other aspects such as problem solving or decisions making.

Infused lessons or sometimes known as infusion lessons have been widely used by scholars for the teaching of critical thinking skills in the school context (Lin, 2014; McGuiness et al., 2017; Swartz, 1991; Swartz, Kiser & Reagan, 1999). Lin, (2014) claims that infusion lesson or infused lessons have found to be effective in the teaching and development of students' thinking skills through the learning subjects of school.

Although conventionally it is more evident for the perspective of teaching thinking skills in subjects like science, mathematics and engineering; however, recent studies show evident that thinking skills can also be taught in subjects such as history, geography, moral, creative arts and English language which see thinking skills being practised by students in various disciplinary context (Kurfiss, 1988; Lin, 2014; McGuiness, 1999).

The researcher of this present study attempted to integrate the four cognitive skills (namely: interpretation, analysis, inference and evaluation) out of the six critical thinking core skills as per APA Delphi's definition (i.e. interpretation, analysis, inference, evaluation, explanation and self-regulation) into three selected subjects content (i.e. English Language, Mathematics and Science) of the existing preschool curriculum for the six-years old (implemented in the Trinity Kids group of kindergartens). The existing lessons were therefore restructured as "infused lessons". Each "infused lesson" while maintaining the prescribed contents, for example: "things that float or sink" in science subject; "things that I like to do" in English subject and "comparison of numbers values-within 20" in mathematics subject; includes also all of the four core CTS of interpretation of data and information, analysis of data or information, making inferences on possible solutions as well as to evaluate the decisions or choices made.

In the context of this present study, infusion lessons refer to existing lessons of standard subjects such as Mathematics, English and Science lessons which have been restructured and incorporated with four core skills of critical thinking (*interpretation, analysis, inference and evaluation based on the APA Delphi Consensual Definitions of CTS as in K2-CCTST*).These were implemented by the teacher using various MI based learning activities and thinking tasks focusing on problem solving (such as completing stories, explorations and experiments, discussions, group tasks and projects, inquiry sessions, language games, role play and puzzles, etc.) in a selected preschool classroom for the six-year olds. These infused lessons are designed and used as additional instructional support materials (ISM) developed to help preschool teachers teach CTS to the young children.

Figure 3.4 (below) illustrates this triad relationship of the infused lessons with four core skills of critical thinking and problem-solving tasks being integrated into three selected subject contents of the existing preschool curriculum of Trinity Kids.

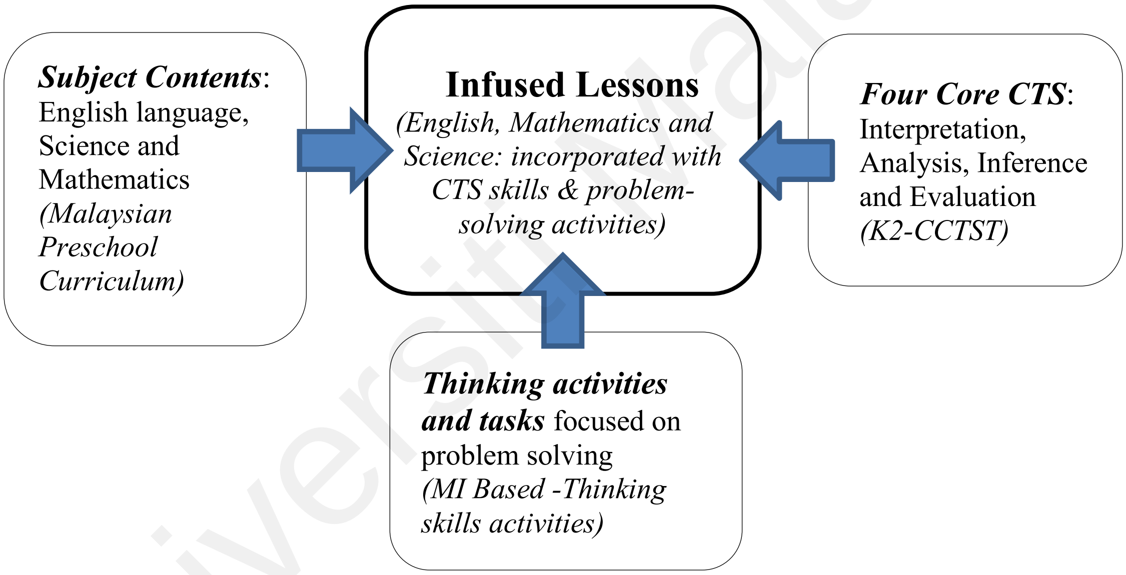


Figure 3.4 Infused lesson- modified model adapted from the "Infusion Approach" of Swartz and Parks (1994)

3.6 The Theoretical Framework

This section discusses on the functions of the main theory and supporting theories which form the theoretical framework of this study. As mentioned in section 1.3 (pg. 17), this study would be underpinned by two main aspects: (1) the infusion of critical thinking skills into the daily lessons of the existing curriculum for teaching CTS explicitly through the lens of infusion approach by Swartz and Parks (1994) and (2) the exploration of the learning and development of critical thinking skills in the preschool classroom through the teaching instructional approach which is based on the theory of multiple intelligences by Howard Gardner (1983, 1993, 1999).

The learning and development of CTS is based upon the basic philosophy of constructivist learning theories whereby children construct learning and thinking based on their past understanding of knowledge and hands-on experiences (Kibui, 2012).

Hence, for this study; two constructivist learning theories were referred to: (a) ‘the Zone of Proximal Development (ZPD)’ to scaffold the learning and development of CTS posited by ‘Vygotsky’s social constructivism’ (1986); (b) ‘Piaget’s cognitive constructivism’ of CTS development in young children (1973).

Piaget’s cognitive constructivism claims that children constantly constructing new meaning or solutions through assimilating and accommodating new knowledge or experiences to their existing knowledge or experiences in order to reach a higher level of thinking as they actively engage in the learner-centred experiential learning environment.

While Piaget emphasised on the perspective of individual cognitive development in critical thinking, Vygotsky argued that the social context perspective in which children learn is equally important for children’s critical thinking development (Robson, 2012). Vygotsky reiterates that the social perspectives of interaction (the interactive and collaborative learning environment) and scaffolding (facilitation by teachers and peer support) are most important in supporting the development of higher mental processes or thinking (Vygotsky, 1987).

In addition, the infusion approach of Swartz and Parks (1994) which was discussed in section 3.5 formed the basis for infusing CTS into existing lessons. The

CTS infused lessons served as an interventional programme which supports the teaching of CTS in the form of ISM (instructional support materials).

In a nutshell, this present study is underpinned by a proposed theoretical framework integrating the constructivist learning theories suggested by Piaget (1973) and Vygotsky (1986) as well as the MI theory founded by Howard Gardner (1993). These two theories were selected and integrated for formulating the theoretical framework on the teaching and development of CTS for this study

In the perspective of this present study, the constructivism learning theory (involving both cognitive and social aspects) supports the thinking intervention or instruction of infusion approach using the CTS infused content (into existing curriculum) where MI theory is adopted as an effective instructional strategy for teaching CTS to the young pre-schoolers. Finally, the outcome of CTS development is to enable the application of CTS for problem-solving.

The summary of the theoretical framework for this present study is illustrated in Figure 3.5 (in the following page). The following sections would further explain and interpret each of the theories in relation to this present study.

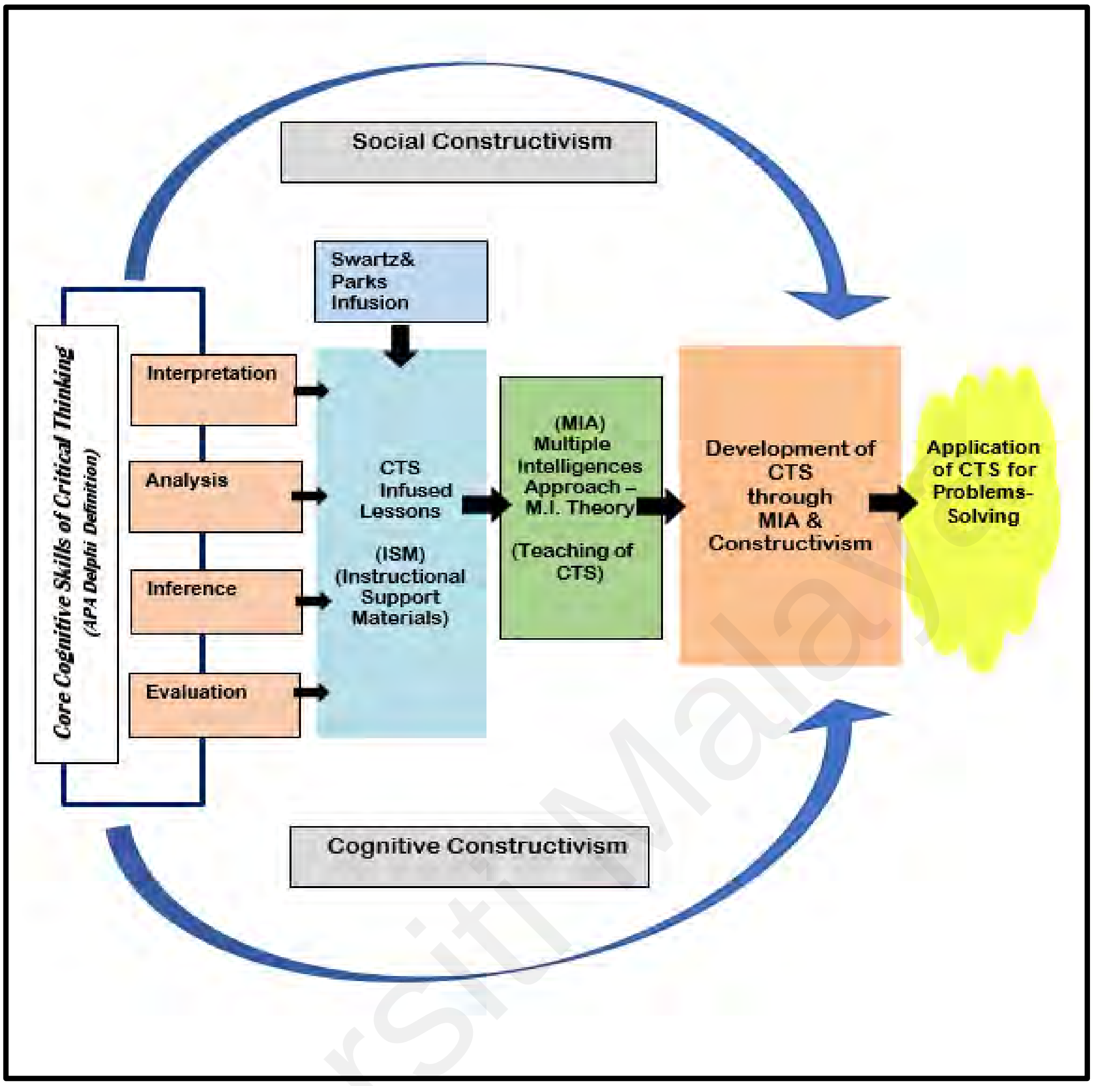


Figure 3.5 The Theoretical Framework of this present study.

3.6.1 The Theory of Multiple Intelligences (MI)

In contrast to numerous theories which focus on the conventional intelligence concepts whereby intelligence is looked upon as a single or restricted entity, the theory of multiple intelligences or MI theory is a theory emphasizing on the cognitive functioning of the pluralization of intelligences which are classified or categorized into different specific modalities that usually work together in complex ways (Armstrong, 2009; Gardner, 1983; 1999; Lunenburg & Lunenburg, 2014). In other word, the MI theory claims that every individual possesses more than one or two intelligences which function either individually as one single intelligence or as a group of two or more intelligences to be operated for more effective learning and thinking. For example, logical-mathematical can function as one strong intelligence in the task of analyzing an issue encountered or it can combine with verbal-linguistic intelligence (as well as interpersonal intelligence) for a verbal brain-storming session (as a group) to discuss on solutions for solving a particular issue or problem.

The model of multiple intelligences proposed by Howard Gardner (1983) provides a new perspective on teaching and learning where teachers are to facilitate the learning of the active learners who prefer to learn and think from a wide variety of ways or modalities (Mehta, 2002; Xie & Lin, 2009).

The MI theory suggests that there are at least eight areas of intelligences or smartness namely: verbal-linguistic / word smart, logical mathematical / logic smart, visual-spatial / picture smart, musical-rhythmic / music smart, bodily-kinesthetics / body smart, naturalist-environmentalist / nature smart, intrapersonal / self-smart and interpersonal / people smart (Figure 3.6) which every child or individual possesses but in various degree and these eight intelligences or strengths are said to be vital for effective learning (Armstrong, 2009, 2017; Gardner, 1993; Nicholson-Nelson, 1998). The theory also suggests that the different strengths of the child influence the way he or she makes sense of the world (Gardner, 1993). In another word, each child has a different intelligence or intellectual profile and thus learns differently from others (C. Lunenburg & R. Lunenburg, 2014; Noble, 2004).

A verbal-linguistic intelligent child has the capacities of using words more effectively either verbally or in writing. A child is said to display strong 'proclivities' or inclinations towards certain intelligences such as verbal-linguistic (VL) when he/she is able to use words (spoken or written) to express himself or herself and to solve related problems. A VL child enjoys learning activities such as stories telling, word games, rhymes and discussions.

All children have different proclivities towards the eight intelligences and may respond better to certain teaching strategies which are inclined to their proclivities (Armstrong, 2009, P. 72). For example, a child who displays proclivities in verbal-linguistic intelligence, tends to respond and learns best from activities related to story-telling, reading, word-games or question and answer while a child who displays proclivities in bodily-kinesthetic intelligence learns best from role-plays, movements and facial expressions, dance and physical-games.

Although Gardner (1999) has identified and established the possibility of the ninth intelligence known as existentialist intelligence but this intelligence has yet to be officially entered into Gardner's list of intelligences as he claimed that existentialist is still unable to fit into all the MI criteria set (Armstrong, 2009), besides the lack of empirical evidence (Roberton, 2012). Armstrong (2009) claims that educators in general, are reluctant to address the existentialist intelligence in the arena of education for fear of religious controversy and at this juncture of time, existentialist seems to have limited pedagogy value to teach curriculum in specific subjects. Scholars and educationists contended that the earlier eight intelligences (namely: linguistic, mathematical, musical, spatial, kinesthetic, naturalist, intrapersonal and interpersonal) are adequate as effective teaching and learning strategies (Delgoshaei & Delavari, 2011; Nobel, 2004; Tajularipin et al., 2010; Zobisch, et al., 2015; Armstrong, 2009 & 2017). Thus, this study would make reference to only the eight areas of intelligences as shown in Figure 3.6.

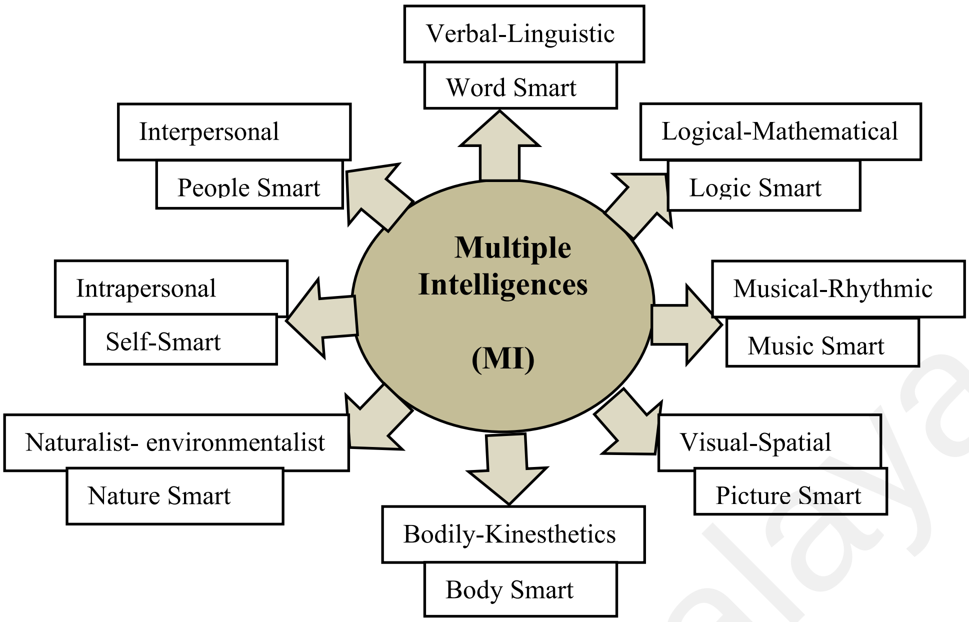


Figure 3.6 The Eight Areas of Multiple Intelligences or Smartness by Howard Gardner

3.6.2 Interpreting Multiple Intelligences Theory for the Present Study

Looking through the lens of MI Theory, an intelligence entails the ability to think critically and creatively in order to solve problems or produce products that are of significance in a particular cultural or community setting (Gardner, 1993; Mehta, 2002). For the purpose of solving problems, learners (or pre-schoolers, in this case) are required to understand the problems or issues involved, analyse the related details or information, reasoning to infer several options or products based on their experiences or knowledge and convert these options or products into solutions (Chi & Shu, 2009; Davis-Seaver, 1994; Facione, 2015; Lai, 2011; Taggart et al., 2005). In other words, the researcher construed that one can be labelled as intelligent when he is able to identify the issues or problems encountered in the everyday lives and apply his critical thinking abilities to solve those problems through creating solutions or products that are of value to his culture or community.

In their study, Noble, (2004); Xie and Lin (2009) and Zobisch et al. (2015) conclude that students who are taught through the multiple intelligences approach which aims to increase students' understanding and actively engaging them in the learning processes, tend to achieve better learning outcomes and they performed significantly better in critical thinking ability. This strongly implies that the MI approach contributes significantly towards effective learning and CTS development where the teaching of CTS can be done through various of modalities which reciprocate with the multiple areas of intelligences.

MI theory which supports the notion of multi-faceted learning seems to provide the ideal platform for the teaching of CTS to be presented in a wide variety of instructional techniques and learning modalities with the aim to effectively address the learners' strengths to best achieve maximum effectiveness in teaching or developing CTS (Zobisch et al., 2015). Studies suggest that the different strengths in children may influence the ways they make sense of the world and thus affect the ways they learn (Metha, 2002).

In the context of this study, MI theory serves as the basis and the backbone of the instructional technique or pedagogy in a contemporary preschool classroom of Trinity Kids which allows the teachers to teach CTS to young children through incorporating the elements of CTS into the various learning subjects and designing a variety of learning activities based on the eight areas of multiple intelligences proposed by Howard Gardner. With the MI model of teaching, teachers are encouraged to identify the MI profile of each child which reflects his/her strengths and thereafter to reach all the children with different learning strengths in a class through employing the MI based learning activities (Mehta, 2002; Tajularipin Sulaiman et al., 2010).

3.6.3 Applying Multiple Intelligences Theory for the Teaching of Critical Thinking Skills

Scholars see the theory of MI as an avenue to provide teachers with more choices of teaching as well as various assessment methods for observing students' thinking and problem-solving skills. (Armstrong, 2009; Xie & Lin, 2009). Xie and Lin (2009) further accentuate that the teaching of critical thinking is one of the main components of multiple intelligences teaching for today's education as true intelligence is seen by Gardner himself as the ability to deal with solving all sorts of problems in the natural world.

Furthermore, according to the new definition of MI by Howard Gardner (1993), intelligences as a bio-psychological potential, are a set of problem-solving skills and the abilities to 'fashion' or create solutions or products that are appropriate for meeting the needs of the community or the world by and large through processing or interpreting information or resources. This implies that the abilities of thinking critically and to resolve real problems in life are the authentic intelligences or abilities required by the twenty-first century. These abilities are in many ways the direct reflections of the existence of the eight intelligences discussed above (3.5.1) which can be taught, developed and nurtured individually or corporately (Xie & Lin, 2009; Zobisch, 2015).

Numerous past studies have disclosed that MI theory has been widely adopted for teaching various subjects such as mathematics, science, health education, language, reading and writing which yielded effectiveness in learning among the learners (Delgoshaei & Delavari, 2012; Lunenburg & Lunenburg, 2014; Noble, 2004; Nwagu & Nwagu, 2013; Weber, 2005). In the study conducted by Zobisch et al. (2015), MI approach to teaching has been adopted as an effective way of teaching critical thinking among the adult learners to enable them "master" or develop better skills for thinking critically. In the same manner, for this present study, MI as a teaching approach is adopted for teaching the selected preschoolers enabling them to develop better CTS through a wide variety of thinking activities which are MI based to offer a variety way of learning.

MI Approach to teaching stresses on the emphasis of being "learner-centred" and advocates for accommodating the various ways of information processing or thinking by the individual student (May 2006). In the MI classroom, teachers are to carefully design the lesson contents using materials which are meaningful and interesting to the different leaners in order to ensure learning outcomes are achieved (Xie & Lin, 2009). Gardner (1999) posits that the learning strengths of the students are said to be closely related to the strongest intelligence or intelligences of an individual. In the context of this present study, existing curriculum and lesson contents are purposefully restructured to include infusion of CTS, besides; all the learning activities are designed to reflect MI characteristics so to enrich the delivery of lesson contents as well as to accommodate the various MI preferences or strengths of each individual student (Armstrong, 2009; Ghamrawi, 2014).

The next section discusses on the learning theory – 'constructivism' which underpinned the teaching and learning of CTS in this present study.

3.7 Constructivism and the Instructional Approach

As the source of verified instructional strategies, learning theories provide the integration of the selected strategy within the instructional context linking components of contents and instructional techniques for facilitating the teaching and learning of specific learners more effectively (Ertmer & Newby, 2013). The role of the selected learning theory in this study also serves to support the theoretical framework of this study in connecting the relationship between the approach for the teaching of CTS, the content and the technique involved. In the context of this study, the selected approach is in the form of "infusion approach" for teaching CTS as the "CTS infused lesson"- the contents; through the instructional techniques based on MI theory, the "MI approach". These three elements seem to be well-integrated by the learning theory of constructivism as shown in Figure 3.7.

In this section, the two perspectives of constructivism leaning theory such as the thoughts of cognitive constructivism (Piaget, 1973) and the thought of social constructivism (Vygotsky, 1986) are discussed in line with each of its function and its support to the teaching and development of CTS in this present study.

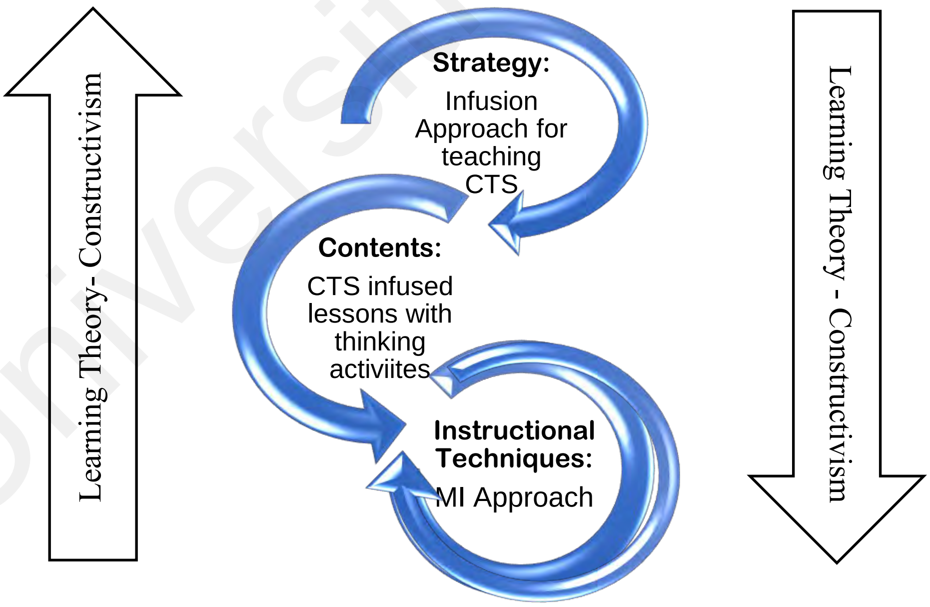


Figure 3.7 The Role of Learning Theory: Bridging the Strategy, Component of Contents and Instructional Techniques.

3.7.1 Interpreting the Perspective of Constructivism for the Teaching and Development of CTS

Although there is no universal definition of constructivism but in a broad sense, the learning theory of constructivism assumes that knowledge and thoughts are actively constructed by the learners. Learners develop deeper appreciation of the earlier knowledge through the interaction with materials, information, experiences and environment around them (Davis-Seaver,1994; Davis-Seaver, Smith & Leflore, 1998; Watts, Jofili & Bezerra, 1997). The perspective of constructivism postulates that the construction of learning or 'thinking' takes place more effectively in the minds of the learners and in the form of mental process through their active physical actions and hands-on experiences (Kibui, 2012).

Constructivists see critical thinking as an ongoing process of making sense or actively interacting within the learners' learning environment or experiences in and out of classrooms, engaging actively in solving daily conflicts or contradictions (Davis-Seaver, 2000; Kibui, 2012). In another word, the content for teaching critical thinking should be "alive" or "active" and not 'dead' or 'passive', being inseparable from the thinking processes which is driven by on-going questioning, analysing, synthesising and evaluating of the minds (Lunenburg, 2011). Learning and development of CTS is assumed to take place when learners actively internalize knowledge through the process of accommodation and assimilation (Kibui, 2012). This leads to the construction of their own understanding and building new knowledge upon their current knowledge or constantly sharpening the skills they develop through active hands-on practices in real life scenarios (Pritchard, 2009). On the same note, learners are encouraged to construct learning or improve their level of thinking through their interactions with the facilitators, peers or their immediate social environment (Amineh & Asl, 2015).

The practice of constructivism calls for teachers to be facilitators who scaffold or support children's learning by giving due consideration for learners' ready knowledge and experiences in relation to the activities and environment (Roya Jafari Amineh & Hanieh Davatgari Asl, 2015). Teachers or facilitators are to provide diverse ways of learning activities which challenge children to apply the existing level of their learnt knowledge or experiences and to increase the level of their knowledge or thinking abilities in order to construct new interpretation or meaning for resolving more challenging issues or problems (Davis-Seaver, 2000; Ertmer & Newby, 2013). This means that teachers in the constructivist classroom are to mindfully create problem-solving oriented learning activities and environment in which the children can learn and construct their own understanding so that they can create better solutions. Besides, teachers' modes of instruction for teaching CTS involving constant interactions and discussions with children is often assumed as a support or scaffolding of the development of thinking skills (Smolucha & Smolucha, 1989; Wass, Harland & Mercer, 2011).

Reciprocally, for the young preschoolers to actively learn to think more critically in their day-to-day classroom, they require a learning environment furnished with engaging thinking activities which foster critical thinking (e.g. interpreting, analysing, examining, reasoning tasks, group discussions) whereby children are challenged to construct deeper understanding of what they have learnt or experienced and to restructure their thinking based on the learnt knowledge and experiences to "invent" new ideas or solutions to 'match' the real world outside the classroom (Amineh & Asl, 2015; Watts et al., 1997).

In the case of learning and developing of CTS in the constructivist preschool classroom, young learners are encouraged to reflect through leveraging on their previous knowledge or experiences, argue or reason prior to constructing hypothesis as well as to decide on the strategies of solutions beyond their current or past knowledge and experiences (Kibui, 2012). Children gain better critical thinking proficiency when they talk to or discuss with their teachers who are more experienced in life about their thoughts, reasonings or arguments on issues concerned (Smolucha & Smolucha, 1989). Gary (1997) claims that constructivist teaching fosters critical thinking as it motivates and create learners who are autonomous and inquisitive. Figure 3.8 is an illustration of the model of a constructivist classroom.

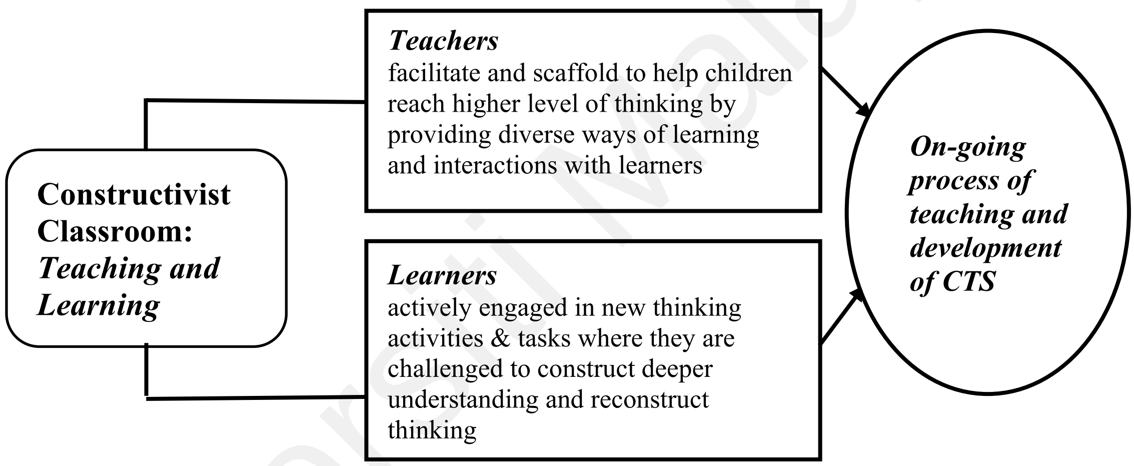


Figure 3.8 The Constructivist Classroom Model

In this study, two main perspectives of constructivism are the main considerations for the process of teaching and developing CTS among the preschoolers: (1) Piaget's cognitive perspective of constructivism and (2) Vygotsky's perspective of social constructivism. Both perspectives are discussed in the following sections.

3.7.2 Piaget's Cognitive Constructivism

Piaget's cognitive development theory (1977) suggested that children do not begin to reason or think about thinking in the form of formal operations until the adolescence stage, many thinking experts strongly advocate that young children are found capable of thinking critically during their early years (Davis-Seaver et al., 1998). However, the cognitive constructivism perspective of Piaget (assimilation and accommodation, equilibration and disequilibration) adequately supports the teaching, learning and development of CTS among the young learners (Roya Jafari Amineh & Hanieh Davatgari Asl, 2015). According to Piaget (1977), when children are challenged to think critically which is in conflict to their current thinking, they encounter cognitive disequilibration (Gray, 1997). They experience a cognitive constructivism process as they take possession of the new mode of thinking by internalizing the new information, generate new understanding and create a new level of thinking in driving for equilibration (Gray, 1997; Lunenburg, 2011). The new information received, or issues encountered by children are "assimilated" into their existing mental framework followed by restructuring or reorganising their present mental framework to "accommodate" the new information through a higher level of analytical or critical thinking (Luneburg, 2011; Roya Jafari Amineh & Hanieh Davatgari Asl, 2015).

Through the constructivist perspective of Piaget (Figure 3.9), when children encounter a challenging new situation or issue in contradiction to their existing way of thinking, a state of ***disequilibrium*** or imbalance occurred and there is a need to alter the way of thinking to restore equilibrium. They then try to make sense of the new experience by ***assimilating*** it into their existing knowledge through *interpreting* and *analysing* the information of the new issue (Gray 1997). In the case where children are unbale to assimilate the new information into the existing structure, a change in thinking is required to ***accommodate*** these information (Caruso, 2015; Gray, 1997). The change of "thinking way" involves a restructuring that leads to a higher level of thinking where ***equilibrium*** is restored (Gray, 1997; Roya Jafari Amineh & Hanieh Davatgari Asl, 2015). In the context of this study, the higher level of thinking implies critical thinking where children can make better sense of the new issues to infer further possible outcomes or solutions and to evaluate the effectiveness of the decisions made (Caruso, 2015; Gray, 1997).

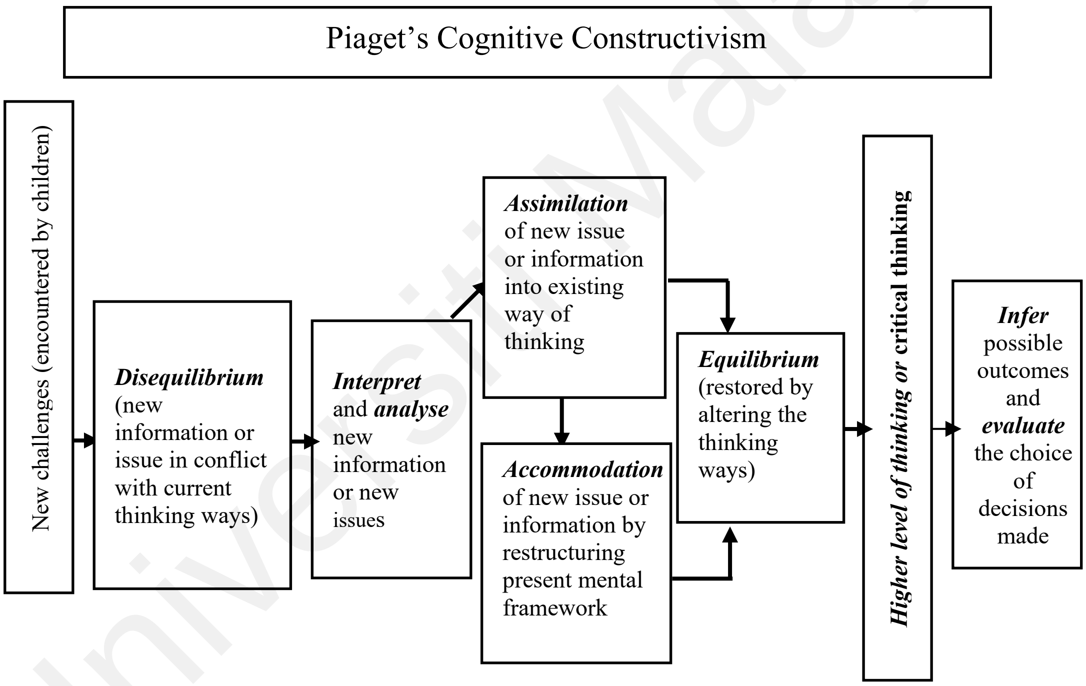


Figure 3.9 The perspective of Piaget's Cognitive Constructivism for the development of critical thinking skills in young children.

3.7.3 Vygotsky's Social Constructivism

In the perspective of Vygotsky's social constructivism, teachers are seen as the model for critical thinking who render additional guidance to help and scaffold children in tackling tougher critical thinking tasks or children may rely on each other's support to think of solutions for solving more challenging problems (Smolucha & Smolucha, 1989; Wass et al., 2011). This implies that the guidance or assistance from teachers and interactions or peer-support from fellow learners who work in groups enable children to reach a higher level of development in the thinking skills which is known as the zone of proximal development (ZPD). ZPD (Figure 3.10) is a model created by Vygotsky for describing how the developmental potential of the mind (or thinking) is attained from a social and cultural context whereby under the verbal guidance of the teacher or collaborative learning with peers, children are enabled to develop deeper critical thinking skills through asking more evaluative questions and attempting to solve more challenging thinking tasks (Fani & Ghaemi, 2011; Roya Jafari Amineh & Hanieh Davatgari Asl, 2015; Wass et al., 2011).

In relation to this study, the Vygotsky's perspective of teaching CTS is displayed through various modes of instructions such as verbal instructions, interactions between teachers and students, questions and answers, group discussion among children as well as group projects of collaborative problem-solving (or thinking) tasks during the delivery of the CTS infused lessons (Smolucha & Smolucha, 1989). In this context, teachers must develop meaningful problem-solving oriented activities which are based on children's interests. Children learn to construct deeper understanding and are stimulated to a higher level of thinking through their interactions and collaborations with more capable adults or peers in a social platform while language is being used as an essential tool of social construction (Roya Jafari Amineh & Hanieh Davatgari Asl, 2015).

Many scholars attest that in order to teach critical thinking skills more effectively, teachers need to be able to scaffold critical thinking in the children's Zone of Proximal Development (ZPD) by structuring carefully the thinking activities and providing additional guidance to help children reach a higher level of thinking achievement (Smolucha & Smolucha, 1989; Winsler, 2003).The supports or scaffolding can then be removed when children reached their potential level (Winsler, 2003; Wood, 1986). In the next level, teachers are to pose more challenging questions which require the students to use higher levels of reasoning in order to for children to be engaged in thinking more critically (Leat and Nichols, 1997; Smolucha & Smolucha, 1989). When teachers set up a more conducive environment for children to explore more challenging thinking tasks, this will enable children to achieve a more proficient level of thinking as they tackle much harder tasks and thus learn to do more than what they could do in a less conducive environment (R. Wass& C. Golding, 2014). In short, the ZPD bridges children's actual critical thinking proficiency level and the potential thinking proficiency level (Fani & Gaheni, 2011; Foong, 2012; Roya Jafari Amineh & Hanieh Davatgari Asl, 2015; Smolucha & Smolucha, 1989).

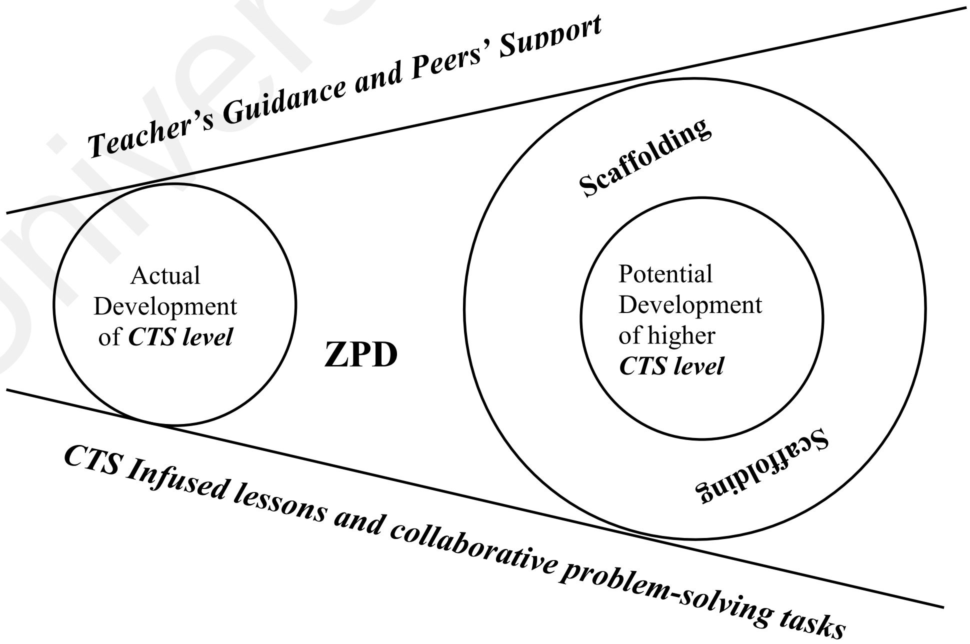


Figure 3.10 Vygotsky's Perspective of ZPD for children's CTS development: (Teachers' guidance and peers' support scaffold the actual level to reach the higher potential level)**.**

3.8 Summary of the Chapter

This chapter began with previous discussions on CTS by various scholars providing an overview on several issues related to CTS such as reflection on the thinking abilities of children, effective strategies and approaches, assessment and application as well as MI theory. Next, the discussion of the conceptual framework and theoretical framework whereby the support of various theories were explained.

MI theory was explained in the perspectives of its interpretation and application for this present study as well as its relationship with the constructivism theory of learning and the teaching of CTS. MI theory provides the 'backbone' to multi-faceted teaching enabling teachers 'reach' their students who learn differently one from another due to the different intelligences in them which makes each of them unique. They require different ways of learning to help them construct understanding of knowledge or thinking of issues in line with their learning strengths or preferences.

The role of learning theory for integrating the strategy, content and instructional techniques was bridged through the constructivism learning theory. The constructivism learning theory comprises the social cultural perspectives of Vygotsky's theory as well as the cognitive perspectives of Piaget's theory whereby children constantly constructing new meaning or solutions through assimilating and accommodating new knowledge/experiences to their existing knowledge/experiences in order to reach a higher level of thinking as they actively engage in the learner-centred experiential learning environment.

The next chapter would discuss the details on methodology, research design, the data collection techniques and data analysis involved for this present study.

CHAPTER 4

METHODOLOGY

4.1 Introduction

This chapter discusses on the methodology of exploring the development of CTS in a preschool classroom. It also describes how this study was conducted and the various phrases of obtaining the data for analysis. The main purpose of this present study is to explore 'how critical thinking skills can be taught by teachers' and 'how are critical thinking skills developed among the preschoolers of six years old in a selected preschool classroom'. Besides describing the developmental process of CTS, this study also intends to explore 'how the developed critical thinking skills can be applied for other tasks' such as problem solving or creating solutions in other contexts.

Thus, this chapter firstly discusses and describes the research design involved and the rationale of adopting a case-study where both qualitative and quantitative data were collected for this study. Secondly, the description of this in-depth case study and the justification on the choice of the specific site as well as the sample of participants selected from Trinity Kids is explained. Thirdly, the procedures of this study and the preparation of the instructional support materials (ISM), in the form of CTS infused lessons to be implemented by the teachers through the MI based instructional approach is discussed. In addition, the profiling of students' MI from selected preschool class as well as assessing the level of CTS among the preschoolers before and after the implementation of ISM are also discussed. Fourthly, the descriptions of the methods for collecting data which include observation (in audio and video formats), problem-solving tasks, interviews and assessments of CTS (using two sets of assessment tools) are provided. Finally, the discussion on the analysis and the triangulation of all the data collected including its validity and reliability aspects are reported.

4.2 Research Design of This Study

Motivated by the interest to explore on how CTS can be developed among young children, the researcher of this present study has taken on a case-study research design which is interpretive, descriptive and constructivist (Merriam, 2009). This exploratory case study is in the form of an embedded single case study as an empirical inquiry of in-depth analysis to facilitate the exploration of CTS development within a bounded system (among a class of selected preschoolers), within a real-life context (a typical preschool) where MIA (Multiple Intelligences Approach which is based on MI Theory) was adopted as the teaching approach.

The exploration of CTS development through the approach of MI requires the researcher to study the impact of leveraging on the MI approach in enhancing the development of CTS. In this study, the MI approach involves the grouping of children according to their various MI dominant strengths or profile. The embedded case allows a more detailed level of inquiry in identifying emerging themes across a few smaller units in relation to CTS development through the various MI groups. There were about four to six children in each of the four MI groups identified. The grouping procedure of preschoolers according to their MI profile would be discussed in section 4.5.3 of this chapter. In this embedded case study, the main unit of analysis was the selected preschool class of twenty students. The smaller units were the four MI groups of preschoolers.

This present study utilized four of the six possible sources of data collection techniques which are qualitative in nature. These data include observations, interviews, focus groups and audio-visual recording. In addition, the quantitative data was collected from the assessments of CTS levels conducted before and after the ISM implementation. The details of data collection techniques would be further discussed in section 4.7. The research design of this study is illustrated in Table 4.1.

Table 4.1
Research Design of This Study

Research Questions	***Data Collection Techniques***	***Data Analysis Outcomes***
1. What is the framework and the features of the MI-based CTS infused lessons {as the instructional support materials (ISM)} for implementation among the selected six-year-old preschoolers of Trinity Kids?	1. Feasibility Study – Critical Thinking Tasks	1. Framework and features of ISM -1st draft of ISM
	2. Informal discussion sessions with selected teachers	2. 2nd and final draft of ISM
	3. Panel of *ECCE experts	3. Validation: framework and features for ISM
	4. MI Diagnostic Tool- MI profile of selected preschoolers	4. Formation of 4 MI Groups
	5. Class observations (non-participant) • Semi-structured interview (Part D - interview protocol) • Focus group interview (Part C - interview protocol)	5. Descriptions of ISM (Framework and features)
2. What is the level of CTS among the selected six-year-old of Trinity Kids before and after the implementation of ISM?	1. **CCTST-K2	1. ***PSCTS_ Pre and Post assessment drafts
	2. Discussions with ECCE panel or experts	2. Finetuning and validation of PSCTST final drafts
	3. Scoring Rubrics	3. Level of CTS

Table 4.1 *(continued)*

Research Questions	*Data Collection Techniques*	*Data Analysis Outcomes*
3. How is the development of CTS among selected six-year-old preschoolers of Trinity Kids?	1. Semi-structure interviews and class observations	1. Early codes and themes of CTS development
4. How is the acquired CTS among selected six-year- old preschoolers of Trinity Kids applied for problem solving?	1. Thinking tasks (Problem-solving) 2. Observations and focus group interview	1. Application of CTS for solving problems 2. Description of problem-solving process

Note: *ECCE (Early Childhood Care and Education), **CCTST (California Critical Thinking Test), ***PSCTST (Preschool Critical Thinking Test)

4.3 Justification of Choosing the Sample and the Site at Trinity Kids

In line with the focus of the topic of study, this present study has targeted selected six-years old preschoolers specifically in a Malaysian preschool classroom as the bounded system. Within the context of this present study, the researcher focused on a few criteria in the selection of the purposive sample, the more appropriate sampling strategy for a qualitative study (Merriam, 2009; Patton, 2002).

The first criteria to consider in selecting the sampling was the age. In the aspect of cognitive development, Dowling (2013) claimed that children of six years old have better appreciation of the cause and effect relationship, an important element of critical thinking as well as having stronger thinking language to describe experiences, reason and talk about thoughts and feelings (Dowling, 2013). The researcher, having observed and dealt with preschoolers between the ages of four to six for the past twenty-five years, acceded to Dowling's claim.

The second criteria for this purposive sampling was targeting at those preschoolers who have gone through at least two years of preschool education and they are more familiar with the subjects based or curricular learning system and thus are expected to respond to the infused lessons better (Dowling, 2013; McGuiness, 1999). Based on the twenty-five years of experiences working with Malaysian preschoolers in a group of private preschools (Trinity Kids), the researcher of this present study has observed these the six-years old preschoolers (who have gone through two or more years of preschool education) are more prepared and confident to share their experiences or express their opinions as they have stronger language abilities. In addition, this group of preschoolers are expected to be more receptive towards cross curricular or inter-subjects learning as per the 'infused lessons' content of this study.

Due to the fact that this present study is conducted in English Language, the third criteria is thus targeted at preschoolers were more proficient in the English Language, their second language as the infusion lessons and all interviews are conducted and communicated in English. In the Malaysian preschool landscape, English Language is the medium of communication and medium of instruction for most of the established private preschools or international preschools whereby almost all subjects (mathematics, science, character building, art and craft, culinary, personal health, music, etc.) are conducted in English except for Islamic study and the National Language, Malay. Students from private preschools are inclined to be more proficient in the English Language and are able to communicate fluently in English.

Therefore, the purposive sample of this study targeted at the six-year-old preschoolers of with at least two years' exposure of preschool education and proficient in English. A Trinity Kids Preschool was selected as the typical case.

Trinity Kids Preschools Group is a typical group of preschools in Malaysia incepted since 1988 and the researcher was the pioneering members responsible for setting up the group of preschools. During the period of this present study, Trinity Kids owns and operates thirty-three preschool centres. The researcher was also instrumental in incorporating MI theory into the Trinity Kids' preschool curriculum and adopting the teaching approach which is based on MI theory for the past seventeen years (since 2011). Trinity Kids teachers were also trained under the in-house training programmes to employ MIA to deliver the daily lessons whereby all teaching and learning activities are conducted in multiple modalities to facilitate students' effective learning (Armstrong, 2009; Gardner, 1993; Zobisch et al, 2015).

To match the specific criteria and purpose of this study, one specific typical preschool class of twenty preschoolers (six-years-old) was selected from one Trinity Kids Preschool (out of the thirty centres) as the bounded system under the purposeful sampling strategy. Throughout this case study, the researcher utilised the classroom setting of the six-years-old for the implementation of a series of infused lessons. The researcher of this study has obtained relevant consent and permission the top management of the Trinity Kids Group (Appendix A).

In addition, the acquaintance and good rapport between the researcher, the teachers and the students involved in this study served as an advantage for the researcher on the choice of selecting Trinity Kids centre as the bounded system of this study. The well-established interaction and trust among the researcher, the teachers and the students facilitated the drawing of embedded information and smoothened the data collection process. Besides, young children would be comfortable with having familiar teachers and researcher instead of total strangers in their classroom throughout the case study.

4.4 Procedure of the Study

The researcher of this study conducted a brief feasibility study with a small group of selected six-year-old preschoolers at two different Trinity Kids centres each (not including the selected preschool centre for this study) in April 2017, to assess the pre-schoolers' receptiveness and responses towards critical thinking activities and tasks. The purpose and details of this feasibility study are further described in the next section.

Observation data from the feasibility study were utilized for the preparation of thinking activities for ISM which began in July 2017. The preparation process of ISM is discussed in the next chapter, section 5.2. The first draft of ISM consisted of twenty-four lessons of thirty minutes each for three subjects. However, the class teacher advised that a thirty-minutes' lesson would be a rush for conducting all the thinking activities.

The second draft of ISM was completed in early August 2017 with fifteen infused lessons of sixty minutes each (a total of fifteen hours of lessons). Other procedures which are discussed included the preparation and implementation phrases of this study, the pre and post assessment of CTS level as well as a brief discussion on the phrase of CTS application for problem solving (Table 4.2).

Table 4.2
Procedure and Timeline of This Study

Dates	***Procedure***	***Remarks***
25^{th}& 27^{th} April 2017	Feasibility Study (60 minutes per session)	• 8 children selected from 2 Trinity Kids Centres respectively. • Completing 4 thinking activities (worked in duplets) within 60 minutes in the respective centres.

Table 4.2 *(continued)*

Dates	***Procedure***	***Remarks***
12th July 2017	First draft of ISM ready	• 24 lessons infused with critical thinking activities for 3 subjects (English, Science, Mathematics) • Each lesson is 30 minutes. • Thinking activities centred on 4 core cognitive skills.
20th July 2017	Fine-tuning of the first draft of ISM	• Feedback from the class teachers: 30 minutes lessons - insufficient for implementing all learning/thinking activities. • 24 lessons require too much time to complete.
8th August 2017	Second draft of ISM ready	• Having 15 infused lessons of 60 minutes each for 3 subjects instead of 24 lessons of 30 minutes each.
2nd October – 9th November 2017	Implementation of ISM	• Implementation of ISM for 8 weeks. • Conduct Pre and Post assessments of CTS levels before and after ISM implementation • Observation and documentation of ISM implementation. • Audio and visual recording of all ISM lessons delivery.
12th -17th November 2017	CTS Application for problem Solving	• Solving a series of problem-based tasks in the various groups (according to MI profile) • Observation of students' problem-solving sessions.

4.4.1 The Feasibility Study

Three months prior to the actual study, a simple feasibility study was conducted. The purpose of this feasibility study was to ascertain the viability and aptness of assigning critical thinking tasks of a certain level of difficulty to young preschoolers for this study.

The simple feasibility study served firstly to gauge the response of young preschoolers towards critical thinking tasks, secondly the developmentally appropriateness of those thinking tasks and lastly, the feasibility of administrating critical thinking task in the preschool classroom.

This feasibility study utilised four thinking tasks selected from the PSCTST tools and ISM thinking activities as a testing tool to gauge the readiness and ability of critical thinking among the preschoolers through the ways they respond and react while executing all the four critical thinking tasks assigned to them.

These thinking tasks involved various cognitive aspects of critical thinking such as interpreting the requirement of the tasks, analysing the information provided logically, providing possible inferences or solutions and evaluating the reasons for choices or decisions made.

Eight preschoolers of six-year-old preschoolers were specifically selected (upon the recommendation of their teachers) from each of the two Trinity Kids Preschools (TK_A and TK_B) based on the purposive sampling criteria set for this study. The two groups of four children (a total of eight from the two preschools) worked in pairs to carry out all the four thinking tasks assigned to them at the respective preschools.

Both groups from TK_A and TK_B respectively, were required to complete all the four thinking-tasks within the timeframe of an hour. The arrangement of working in pairs allowed children to express and discuss about their “thoughts” with regards to the execution of the tasks.

Working in pairs, the preschoolers were given a duration of sixty (60) minutes to complete the four thinking tasks assigned at the two selected preschools respectively. The four thinking tasks assigned to the preschoolers for this feasibility study were:

1. (Task 1) - ***Sequencing of events*** (Refer to Figure 4.1 and Appendix B) where preschoolers studied, discussed and analysed the series of pictures before arranging them into a correct sequence to form a story by numbering them from 1 to 4. They were to explain verbally the reasons for the arrangement made and to tell the whole story based on the sequence arranged.

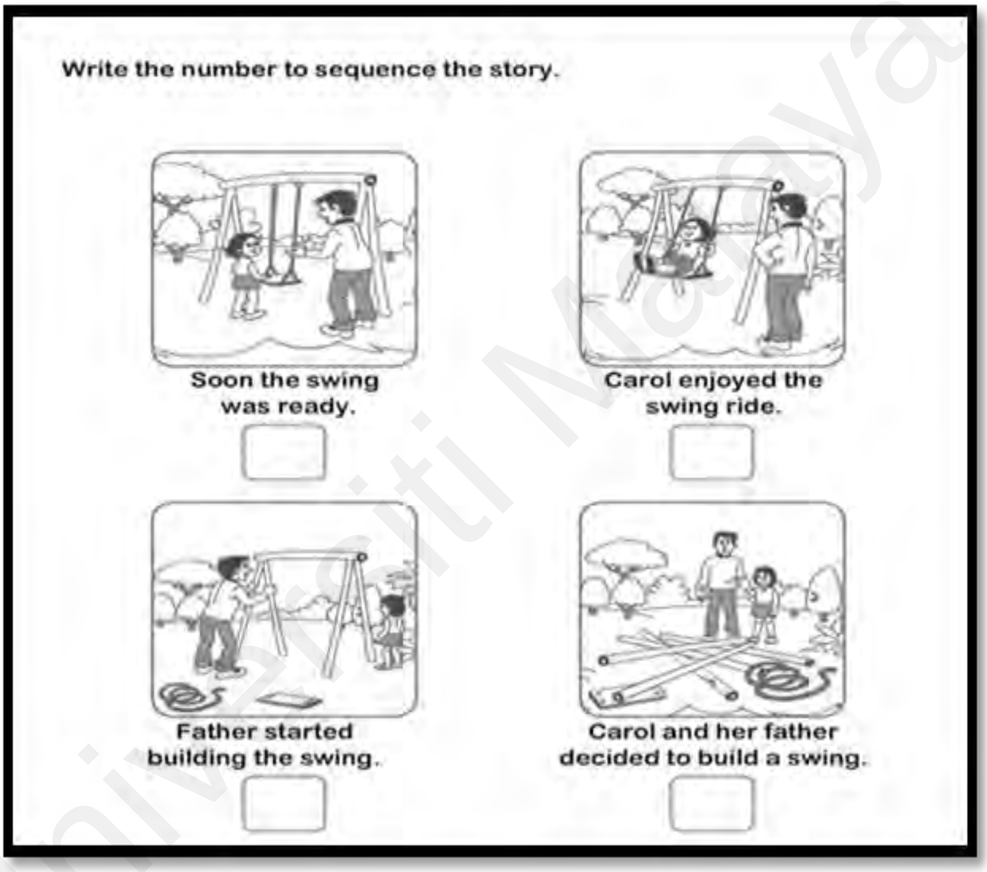


Figure 4.1 Task 1: Sequencing of events

2. (Task 2) - ***The missing number*** (Refer to Figure 4.2 and Appendix B) where preschoolers studied, discussed, interpreted and analysed the series of numbers in the context of patterns, values and sequences before making inferences of the missing number. They were required to evaluate the accuracy of the inferred number and to provide verbal explanation on the inferences made.

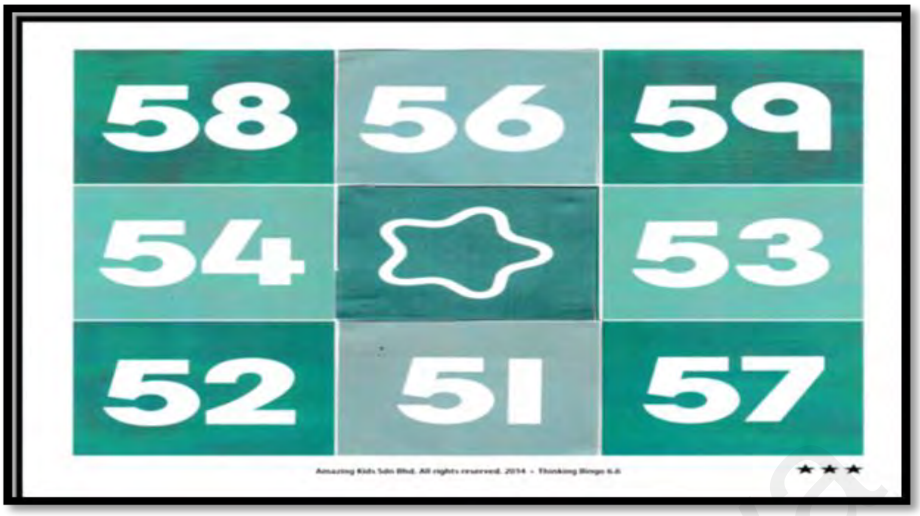


Figure 4.2 Task 2: What is the missing number in the STAR

3. (Task 3) - ***The colourful elephants*** (Refer to Figure 4.3 and Appendix B) where preschoolers observed and examined the details of the four coloured elephants in order to contrast and compare the differences (such as size, colour and shape) as well as to arrange the coloured elephants according to sizes. They were also given extra coloured beads and asked to match them with the elephants in ways that form meaningful relationships. For example: A red bead was matched to a red elephant or a red bead was matched to an elephant with the red oval shape on its body.

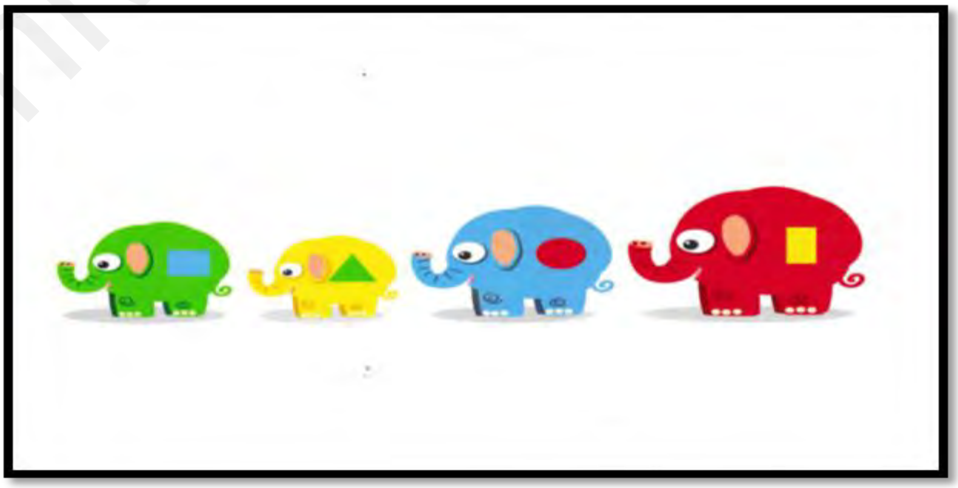


Figure 4.3 Task 3: The Colourful Elephants

4. (Task 4) - ***Logical analysis*** (Refer to Figure 4.4 and Appendix B) where preschoolers listened carefully to information and instruction given by the teacher, to interpret the instructions and analysed the clues and information given before deciding on the choice of answer. They were required to explain the reasons for the choice of answer made.

Figure 4.4 Task 4: Who has the biggest backpack?

4.4.2 Observation from the Feasibility Study

While the two groups of preschoolers worked on the critical thinking tasks in pairs, the researcher observed how they executed the tasks and the evidence of the manners of thinking involved. For examples:

1. Were they enthusiastic about completing the thinking tasks?
2. How did they go about completing or solving the thinking tasks?
3. What thinking abilities did they display?
4. Were they able to complete all the four thinking tasks?

It was observed that in general, both the groups of preschoolers found that task 1 and task 3 were the easier ones to solve. Most of them took a slightly longer time to solve task 2 as they had to spend a longer time on analysing the number patterns, interpreting the sequence of those numbers and justifying the choice of inferred number. Task 4 took the longest time as further reading through of the descriptions and information was required for preschoolers to better understand, interpret and analyse the clues before providing the answer or solution.

The researcher also observed that the two groups of pre-schoolers enjoyed most, the story sequencing and activities of matching information (as in Task 1) as well as comparing and contrasting data (as in Task 3). The preschoolers were able to solve the analytical-mathematical problems which involved making logical inference on the sequence of number through discussing and reasoning with their partners (as in Task 2). They also enjoyed the thinking task which involved the interpretation and investigations of clues provided in order to solve a "problem" or a "case" (as seen in Task 4).

Through the observations on the participation and responses from the two groups of preschoolers in the feasibility study, it was observed that young children enjoyed the thinking activities and they were enthusiastic about completing those thinking tasks. The findings of the feasibility study were shared with the selected teachers and the ECCE experts for verification. The researcher then proceeded with preparing the ISM of lessons infused with CTS (in the form of teaching activities) and the preparation of PSCTST, the pre-assessment prior to ISM implementation and post-assessment after the ISM implementation.

4.5 Preparation of CTS Infused Lessons as Instructional Support Materials (ISM)

In this study, ISM is the vehicle employed for teaching CTS explicitly through infused lessons. The main content of the ISM lessons comprised of teaching activities infused with the four core cognitive aspects of the CTS discussed earlier. The framework for drawing up ISM and the implementation is further described in Chapter 5.

Prior to the preparation of ISM, the researcher had numerous informal meetings and discussions with the team of experienced preschool teachers who have been involved with teaching and educating preschoolers for the past few years at the selected Trinity Kids Preschool centre. The two subject teachers (Ms. F and Mdm. M) and one class teacher (Mrs. N) were teaching the class currently and would be involved with implementing the ISM (infused lessons). The aims of the discussions were to facilitate and abet the preparation of the appropriate contents for the ISM set.

Upon completion, the draft of ISM was further discussed with a panel of ECCE (Early Childhood Care and Education) experts (as listed in table 4.3) which included the preschool curriculum developer and the preschool principal to enhance the validity of the ISM contents. This would be further discussed in the next section.

4.5.1 Enhancing the Validity of the Instructional Support Materials (ISM)

The researcher of this study has been intensely involved with curriculum development for the preschools over the past twenty-five years. Besides being instrumental and responsible for developing the preschool school curriculum for Trinity Kids group of preschoolers since 1994, the researcher also sits in the review panel of the national preschool curriculum for the Ministry of Education (MOE) for Malaysia. Although, the researcher has the expertise in developing the ISM (infused lessons into the existing curriculum contents designed with MI activities), but the input and view-points from the preschool curriculum experts (the curriculum developers), the ECCE lecturer and three senior teachers who have been teaching daily in the classroom for more than a decade was essentially important.

In order to enhance the validity of the ISM, drafts of ISM were reviewed by a panel of early childhood education experts from Trinity Kids, private university and Ministry of Education (MOE). This team of seven experts comprised of one Curriculum Developers (with 10 years of experience) from the head office, one Preschool Curriculum Developer form MOE (with 7 years of experience), one ECCE lecturer from the private university (with 10 years of experience), one Principal (with 17 years of experience), one class teachers(with more than 10 years of experience) and two subject teachers(with more than 7 years of experience) from the selected centre (of this study)as shown in Table 4.3 below. The drafts were discussed with the panel for their feedback and recommendations in July 2017.

Table 4.3
List of Early Childhood Education Experts for Validating the ISM

Panel	***Number***	***Years of Experiences***
Preschool Curriculum Developer (in-house_ Trinity Kids)	1	10 years
Preschool Curriculum Developer (Ministry of Education, Malaysia)	1	7 years
Lecturer (ECCE Course, Private University)	1	10 years
Preschool Principal (Trinity Kids)	1	17 years
Preschool Class Teachers (Trinity Kids)	1	10 years
Preschool Subject Teacher (Trinity Kids)	2	7 years

Basically, the contents of all these lessons in the ISM set were taken from the existing lessons infused with CTS and were modified and refined. However, from the feedbacks and comments collected from the two review and discussion sessions conducted with the above experts, these were the recommendations highlighted:

(a) Some explorative activities require longer time for execution, for example various groups of students were asked to collect seven (7) items from the garden (outside the classroom, the playground or the canteen respectively) for one of the English lessons. The panel of experts felt that the original ten minutes allocated was insufficient. Therefore, the researcher has extended the time allocation for those activities from ten minutes to fifteen minutes.

(b) Some lessons seemed overly packed with four thinking activities for the teacher to implement within the given forty-five minutes. For example, in science lesson 5 (the final lesson); four learning activities were originally suggested: (1-Which objects are attracted by magnets? 2-Properties of magnets. 3-Which pole is this? 4-What is magnetism?). The panel opined that four learning activities were too challenging for the teacher to implement. Thus, the researcher reduced the number of activities for that particular lesson from four to three instead to allow the teacher to implement each learning activity more smoothly.

(c) Some instructions for the thinking activities were found to be a little too tough for the preschoolers in view of the fact that English Language was the second language of these preschoolers. The researcher had further simplified and rephrased the sentences in order to make it more comprehensive for the selected preschoolers. For example, in a question "Are you able to 'interpret' the information of this question/task?"; the researcher had rephrased it as "Do you 'understand' the meaning of this question or task?"

The ISM drafts were fine-tuned and refined based on the feedback and recommendations of the five preschool experts before finalising and confirming with the team of Principal and teachers from the selected preschool centre. The existing curriculum for the ISM has been in used over the past five years in Trinity Kids Preschools. Thus, there were only few amendments required to accommodate the additional thinking skills and tasks. The final draft was completed and examined by the panel of experts by September 2017. The ISM set was ready for implementation in the preschool classroom on 2nd October 2017 as per the schedule of this study. (Refer to Appendix C for the sample lesson plans of ISM lessons.)

4.5.2 Multiple Intelligences (MI) Diagnostic Tool

One month prior to the implementation of the ISM, two informal meetings were held between the researcher with the Principal and the three teachers involved in this study for planning and diagnosing the MI profiles of the selected preschoolers. As discussed in section 2.6.2, the pictorial MI diagnostic or profiling tool was adapted from the existing profiling tool (MI Diagnostic Chart) used by Trinity Kids group since 2011 of which the researcher was instrumental in developing it together with the team of preschool curriculum developers from Trinity Kids basing on MI theory (Gardner,1999) and the MI checklist from Armstrong (2000; 2009). As discussed in section 2.7.2, the pictorial MI diagnostic tool was preferred as it more suitable for young children. Besides, this pictorial MI diagnostic tool (Appendix D) was more user-friendly for teachers and parents.

The MI diagnostic tool was designed with a total pf sixty-four (64) MI elements in pictorial form (Figure 4.5). For each of the eight MI strengths, there would be eight (8) elements that describe the various strengths or intelligences. For example, there are eight (8) elements to reflect the MI of verbal-linguistic (VL) such as writing, reading, word-games, listening, storytelling, speech, vocabulary and debate.

The number and details of elements or items for the MI diagnostics tool were based on the models suggested by Armstrong (2009) and Candler (2011). Armstrong suggested ten elements for the older students and adults while Candler suggested six elements for young children. For this study, the researcher adopted the diagnostic tool developed with reference to Armstrong and Candler's models adapted and developed by the team of curriculum developers of Trinity Kids. These eight MI have been carefully selected as deemed appropriate for preschoolers by Trinity Kids curriculum development team.

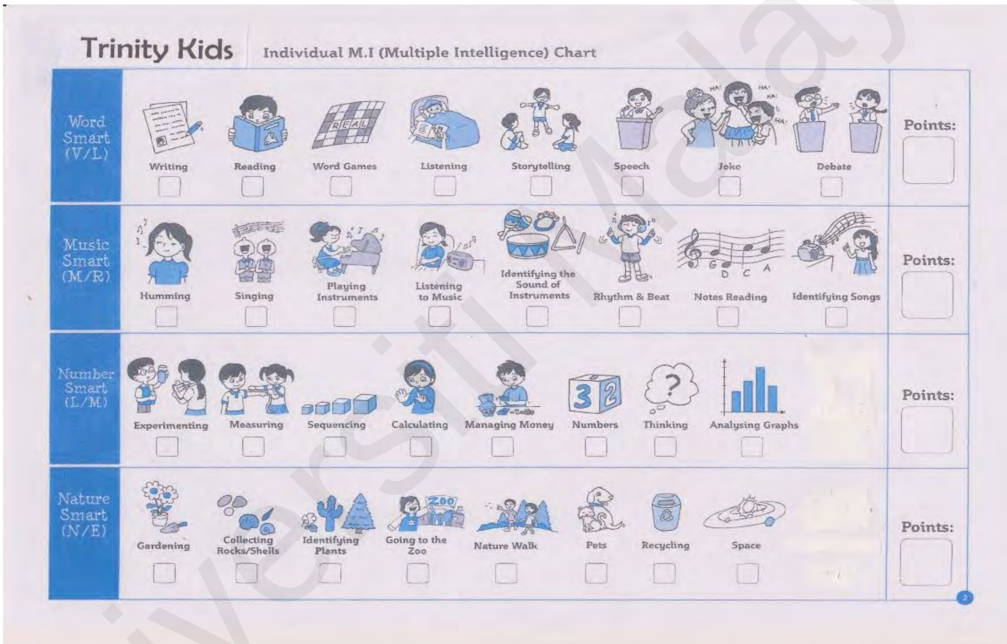


Figure 4.5 MI Diagnostic Tool -Examples of elements for VL, MR, LM and NE

For this study, selected teachers have observed and identified those elements of intelligences which reflected the proclivities or inclination of strengths displayed by the individual child. In this study, both the class teacher (Teacher N) and subject teacher (Teacher F) were to tick those MI elements displayed by each of the twenty preschoolers individually on the MI diagnostic/survey tool (as shown in Figure 4.6). The total number of ticks reflect the various MI strengths of the individual preschoolers. Preschoolers of the similar MI strengths are grouped together into various MI groups. The outcome of the profiling was used for forming the four MI heterogeneous groups in this study.

Figure 4.6 MI Diagnostic Tool - Example of MI Profiling (Part One)

The MI diagnostic tool of this study was further validated by two other preschool curriculum developers who had obtained the certificate (Using MI as a tool to help students learn) from Harvard University (online course) and the head of curriculum development from the Ministry of Education (MOE), Malaysia. The details of the experts would be also described in section 4.9 of this chapter.

4.5.3 Multiple Intelligences (MI) Profiles of Selected Preschoolers

Over the decade, Trinity Kids teachers found the MI diagnostic tool very helpful and highly accurate in identifying and knowing the preschoolers' strengths. The MI profiling of the individual preschooler was done through marking the various MI elements which indicate the MI strengths of the individual preschooler.

The intention to diagnose and profile the different areas of MI for the preschoolers in this study was to enable the teacher to group the selected preschoolers with the similar strongest strengths into various MI groups. The aim of forming MI groups is meant for facilitating optimum learning and skill development among the selected preschoolers.

For this study, the MI diagnostic tool was administered separately by two teachers (Teacher N, the class teachers and Teacher F, the subject teacher) on 9th October 2017 and 10th October 2017 respectively. The two teachers were very familiar with the selected preschoolers having to teach the class for more than a year. Based on their observations and assessments, two sets of MI scores for the twenty selected preschoolers were produced. However, few minor variations were found in the both the MI diagnostic scores records. These two sets of profiles with minor variations were being compared and discussed before a final endorsed profile of MI was agreed upon. The final endorsed MI profile was used as the reference for the purpose of forming the various MI groups. Tabulations of the MI strengths based on the data collected from the two MI diagnostic scores by the two teachers were illustrated in table 4.4.

Table 4.4
The MI Profile Compiled by Class Teacher (Teacher N- red) and Subject Teacher (Teacher F- blue)

No.	***Names***	***VL***	***LM***	***VS***	***MR***	***BK***	***NE***	***INTRA***	***INTER***
1.	KidA	4(4)	2(3)	4(4)	6(6)	5(5)	6(7)	4(4)	7(7)
2.	KidB	7(7)	6(6)	4(4)	3(4)	5(4)	5(5)	6(5)	7(7)
3.	KidC	7(7)	5(5)	4(4)	7(6)	6(6)	5(5)	7(7)	7(8)
4.	KidD	8(7)	7(6)	5(5)	7(6)	7(7)	6(6)	6(5)	7(7)
5.	KidE	4(3)	3(3)	4(4)	3(2)	5(5)	7(7)	4(2)	8(8)
6.	KidF	4(3)	5(3)	6(4)	3(3)	5(5)	7(7)	4(4)	6(6)
7	KidG	7(7)	8(6)	7(6)	7(7)	6(4)	6(6)	5(3)	7(7)
8.	KidH	7(6)	8(4)	6(6)	3(2)	5(5)	6(6)	5(5)	6(6)
9.	KidI	6(6)	6(4)	7(5)	6(7)	6(6)	5(5)	4(4)	6(6)
10.	KidJ	8(8)	7(7)	6(6)	7(7)	5(5)	5(7)	7(7)	8(8)
11.	KidK	8(7)	7(7)	6(6)	5(5)	5(5)	6(6)	5(5)	7(7)
12.	KidL	7(6)	8(7)	5(5)	4(4)	5(5)	5(6)	5(5)	7(7)

Table 4.4 *(continued)*

No	*Names*	*VL*	*LM*	*VS*	*MR*	*BK*	*NE*	*INTRA*	*INTER*
13.	KidM	**5**(5)	**4**(7)	**2**(2)	**3**(3)	**5**(4)	**6**(6)	**4**(4)	**4**(5)
14.	KidN	**5**(5)	**6**(6)	**5**(5)	**2**(2)	**5**(5)	**5**(5)	**5**(4)	**5**(5)
15.	KidO	**6**(6)	**5**(5)	**4**(6)	**7**(7)	**6**(6)	**6**(6)	**7**(7)	**7**(7)
16.	KidP	**4**(4)	**4**(4)	**5**(5)	**3**(3)	**5**(4)	**7**(7)	**6**(5)	**7**(7)
17.	KidQ	**6**(6)	**6**(6)	**6**(6)	**7**(8)	**4**(5)	**5**(5)	**6**(6)	**7**(7)
18.	KidR	**7**(5)	**4**(4)	**6**(6)	**5**(5)	**4**(5)	**5**(4)	**3**(3)	**7**(7)
19.	KidS	**5**(5)	**6**(6)	**5**(5)	**3**(3)	**5**(5)	**8**(8)	**7**(5)	**8**(7)
20.	KidT	**6**(6)	**6**(6)	**8**(8)	**8**(7)	**6**(6)	**6**(6)	**5**(5)	**8**(8)

Further to that, a simple "interactor reliability" exercise was conducted to further validate the diagnostic outcome or profile of MI. The total number of elements for all the eight MI were one hundred sixty (160), the number of similar elements recorded by both the teachers were one hundred and thirteen (113). Therefore, after comparing both sets of scores, the inter-actor reliability indicated about seventy-one (71%) percent. Thus, the MI profiles scores for this study is acceptable. Table 4.5 illustrates the four MI groups formed based on the MI strengths as per recorded in the endorsed MI Profile.

Table 4.5
The Endorsed MI Profile and MI Grouping of Selected Preschoolers

No.	*Name*	*Group*	*VL*	*LM*	*VS*	*MR*	*BK*	*NE*	*INTRA*	*INTER*
1.	KidA	**NE**	4	2	4	5	5	7	4	7
2.	KidB	**VL**	**7**	6	4	3	5	5	5	7
3.	KidC	**VL**	**7**	5	4	6	6	5	7	7
4.	KidD	**VL**	**8**	6	5	6	7	6	6	7
5.	KidE	**NE**	4	3	4	3	5	**7**	4	8
6.	KidF	**NE**	4	5	6	3	5	**7**	4	6
7	KidG	**LM**	7	**8**	7	7	6	6	5	7
8.	KidH	**LM**	7	**8**	6	3	5	6	5	6

Table 4.5 *(continued)*

No.	*Name*	*Group*	*VL*	*LM*	*VS*	*MR*	*BK*	*NE*	*INTRA*	*INTER*
9.	KidI	**VS/MR**	6	4	**7**	**7**	6	5	4	6
10.	KidJ	**VL**	**8**	7	6	7	5	5	7	8
11.	KidK	**VL**	**8**	7	6	5	5	6	5	7
12.	KidL	**LM**	6	**7**	5	4	5	5	5	7
13.	KidM	**NE**	5	4	2	3	5	**7**	4	5
14.	KidN	**LM**	5	**6**	5	2	5	5	5	5
15.	KidO	**MR/VS**	6	5	**6**	**7**	6	6	7	7
16.	KidP	**NE**	4	4	5	3	5	**7**	6	7
17.	KidQ	**MR/VS**	6	6	6	**8**	5	5	6	7
18.	KidR	**MR/VS**	5	4	**7**	**6**	5	5	3	7
19.	KidS	**NE**	5	6	5	3	5	**8**	5	7
20.	KidT	**MR/VS**	6	6	**8**	**8**	6	6	5	8

*Note: All the names recorded here are pseudonym.

According to MI theory, every individual possesses all the eight areas of strengths but in varying degree (Gardner, 1993). Thus, a child can display equally high scores in a few MI or all MI which means that the child is strong in multiple areas of strengths and is able to learn or accomplish tasks effectively through multiple modalities.

The researcher and the teachers involved have deliberated carefully on forming the MI groups based on the most dominant MI strengths as per the MI profile as well as the day-to-day observations by the teachers. The MI groups formation was to take into consideration that all the eight MI were included or addressed. The details of the MI groups formation would be discussed in next section.

4.5.4 Grouping of Selected Preschoolers According to Their MI Strengths

Forming small groups of preschoolers according to their MI strengths is an application of MI theory into classroom management for cooperative learning (Armstrong, 2009). In this study, the formation of MI groups was based on the outcome of the MI profiling using the MI diagnostic tool. Children who displayed similar strong strengths of a specific area of MI (such as NE) would be grouped together. In the case of children displaying high scores in a few MI (such as NE, VL and LM), the determination of their MI grouping would be further discussed and confirmed by the class teachers and her co-teacher.

The MI profiling score of this group of twenty preschoolers was recorded in the form of "points" ranging from one to eight points (1-8) for each MI strength; with one point as the indicator of the weaker strength while eight points reflecting the indicator of the strongest strengths. A score of five points and above for any of the MI indicates that the child is 'strong' in that particular area of intelligence. The score of four points is considered 'average' while a score of three points and below is classified as 'weak' in that MI. Preschoolers with a strong score of seven (7) or eight (8) in a particular MI strength were placed together as one MI group.

For example, in the case of KidA; her strongest MI are NE (7 points) and INTER (7 points) while her weakest MI are LM (2 points). Her average MI are VL, VS, and INTRA (4 points) while MR and BK are considered as her strong MI.

In other words, KidA's MI profile revealed that she displayed strong proclivities towards naturalist-environmentalist (NE), bodily-kinesthetic (BK) and interpersonal (INTER) intelligences. This implied that she appreciated nature, animals, plants and recycling projects more. Besides, her high scores for BK and INTER intelligences could be due to the culture of working together frequently in class. Thus, she was placed in the NE group as one of the four MI groups.

In this study, the various MI groups formed would include the strengths of INTER and BK as all preschoolers were engaged as a group in learning/ thinking hands-on activities which involved both interpersonal and BK strengths.

Thus, through further discussions and careful deliberations with the class teacher, subject teachers, the principal and the curriculum developers; this panel of ECCE experts concurred that it was more practical to form four groups basing on the strongest MI with INTER and BK as general strengths. The four MI groups were: Group 1 - NE (naturalist-environmentalist), Group 2 - LM (logical-mathematical), Group 3 - VL (verbal-linguistic), Group 4 - MR/VS + INTRA (musical-rhythmic or visual spatial and Intrapersonal) prior to the implementation of ISM illustrated in table 4.6. Note that INTRA strength was included in MR/VS group as the strengths of this group were related more to creativity which required personal appreciation and internalization of feelings.

Table 4.6
The Summary of MI Grouping for the Selected Preschoolers

Groups	***MI Strengths***	***No. of students***
Group 1	**NE** (naturalist-environmentalist) + ***INTER*** (interpersonal) + ***BK*** (bodily-kinesthetic)	***6***
Group 2	**VL** (verbal-linguistics) + ***INTER*** (interpersonal) + ***BK*** (bodily-kinesthetic	***5***
Group 3	**LM** (logical-mathematical) + ***INTER*** (interpersonal) + ***BK*** (bodily-kinesthetic)	***4***
Group 4	**VS** (visual-spatial) or ***MR*** (musical-rhythmic) + ***INTRA*** (intrapersonal) + ***BK*** (bodily-kinesthetic) + ***INTER***(Interpersonal)	***5***
	TOTAL number of students	***20***

Through the formation of MI groups, it was observed that group 1 (NE) has more students (six members) than the other groups while group 3 (LM) has fewer students (4 members). Both the class teacher (Mrs. N) and the subject teacher (Ms. F) confirmed that there were more students from this class who displayed the MI strengths of naturalist-environmentalist (NE) as compared to the logical-mathematical (LM) strengths while very strong verbal-linguistic (VL) strengths were only evident among five students.

As most of the activities of the infused lessons involved group participation or teamwork from the children, thus; the interpersonal (INTER) aspect of the MI was included in the first three groups (1, 2, 3). However, for group '4' (VS & MR) which was more inclined towards the aspect of aesthetic or creativity; where most activities were accomplished individually; therefore, the intrapersonal (INTRA) aspect is more evident for this group. In addition, the aspect of bodily-kinesthetics (BK) was included in all the group as all the thinking activities required hand-on involvement of all children.

4.5.5 Facilitating the Various MI Groups

With the preschoolers being grouped into four MI groups as per discussed in section 4.5.4, a teacher was assigned for each MI group to facilitate the group learning and thinking activities. (Refer to Table 4.7 for the list of facilitators.)

Table 4.7
The Facilitators for the Various MI Groups

Group	*MI Strengths*	*Facilitator/Remarks*
Group 1 (NE)	Naturalist-Environmentalist	Ms. F – Subject Teacher (A science teacher and her strength is related to nature and environment)
Group 2 (LM)	Logical-Mathematical	Mdm. M – Subject Teacher (A mathematics teacher and her strength is in logical analytical skills)

Table 4.7 *(continued)*

Group	*MI Strengths*	*Facilitator/Remarks*
Group 3 (VL)	Verbal-Linguistic	Mrs. N – Class Teacher (Her strength is in teaching languages such as English Language)
Group 4 (MR/VS)	Musical-Rhythmic & Visual-Spatial	Ms. G – Principal (Her strength is in music and creativity)

The class teacher N (Mrs. N) was responsible for teaching the English Language lessons, the subject teacher 1 (Mdm. M) was responsible for teaching mathematics lessons while subject teacher 2 (Ms. F) was responsible for teaching science lessons.

It was interesting to note that the teachers who were facilitating each of the groups made their choice of group facilitation which was in correspondence to their own MI strengths. For example, Ms. F – has more of naturalist-environmentalist strength (NE), Mdm. M – preferred logical-mathematical (LM) as that was her strength, Mrs. N was strong in verbal-linguistic (VL) while Ms. G's strengths inclined towards musical-rhythmic (MR) & visual-spatial.

4.5.6 ISM and MI Based Activities

This present study opts to look at the employment of Multiple Intelligences (MI) Approach for teaching and helping preschoolers develop critical thinking skills. To facilitate this aim, each of the fifteen CTS infused lessons of the ISM set was planned with a few teaching-learning activities which were presented through two-to-three MI based activities. Besides the various MI based teaching-learning activities, every lesson was complemented with additional MI based thinking tasks specifically designed for the respective MI groups to further enhance the learning and application of CTS.

For example, the core skills of “interpretation”, “analysis”, “inference” and “evaluation” were infused into the English, Mathematics and Science lessons respectively in the form of thinking tasks. Every infused lesson (of 60 minutes) comprised of two main teaching-learning activities (40 minutes for presenting the lesson contents) besides the set induction (10 minutes) and closing activity (10 minutes of a problem-solving activity) as illustrated in figure 4.7. Each teaching-learning activity of the lesson was presented through two or three MI activities such as stories or narrations (VL), video clips or pictures (VS), experiments or graphs (LM), songs or rhymes (MR), movement or games (BK), nature observation (NE), group explorations or discussions (Inter) and role-play (Intra) to address the various learning preferences related to all the areas of intelligences.

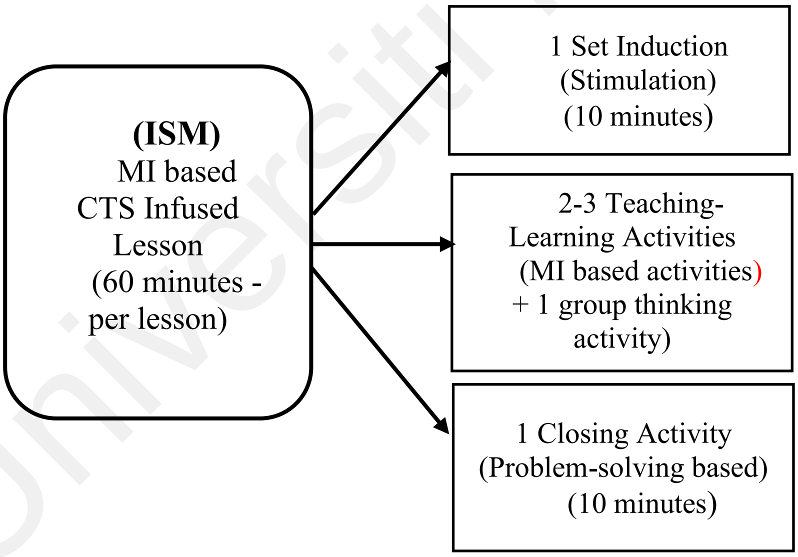


Figure 4.7 Lesson Planning for Every MI based CTS Infused Lesson of the ISM

Table 4.8 illustrates an excerpt of one part of the lesson plan for one of the English lessons used to describe how a lesson was planned with CTS infused and MI based activities for teaching. This excerpt was taken from one of the teaching-learning activities (Lesson 3 on the topic of ‘Farm Animals’) – teaching activity 1: Name of farm animals and the sounds they make. Contents of lesson were taken from an existing lesson and were modified with added group thinking tasks which were integrated with the four core cognitive skills.

Table 4.8

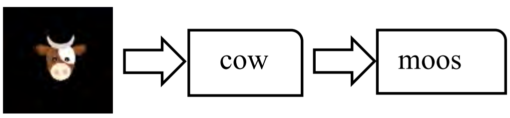
Excerpt of a Lesson Plan - Teaching Activity 1: from an Infusion Lesson of the ISM

Week 45 ***Date: 7th November 2017*** ***Day: Tuesday***

English Lesson 3: Farm Animals

Learning Outcomes: Children are able to:

1. Name various farm animals and the sounds they made.
2. Describe briefly various farm animals.
3. Ask and answers questions on “Can it….?”, “Yes, it can.” or “No, it can’t”

<table>
<tr><th>Activities</th><th>CTS Infused</th><th>MI Elements</th></tr>
<tr><td>Set Induction:
Teacher starts off with a karaoke song. Children are to sing along: “Old McDonald had a farm” with actions together.</td><td>N/A</td><td>MR, NE, BK, INTER</td></tr>
<tr><td>Teaching-Learning Activities (1)
1. Teacher to play a video clip from the lesson resource pack “farm animals and the sounds they made” to introduce sentence structures:
➢ A cat meows. A dog barks
➢ A hen clucks. A horse neighs.
➢ A cow moos. A pig oinks.
Students are to make the various sounds besides acting out the farm animals.</td><td>N/A</td><td>VS, NE, INTRA, BK</td></tr>
<tr><td>2. Teacher displays a set of picture cards of some farm animals (cat, cow, dog, goose, goat, horse and rooster) and as set of word cards (cock-a-doodle-doo, neighs, moos, barks, bleats, cackles, meows). Children are to match the correct picture’ to the correct ‘name’ and ‘name of sound made’.
➢ Teacher: What is the name of this farm animal?
➢ Children: “A cow.”
➢ Teacher: “What sound does it make?”
➢ Children: A cow moos.


Sentences: This is a cow. A cow moos.</td><td>N/A</td><td>VS, VL, BK, INTER</td></tr>
</table>

Table 4.8 *(continued)*

Activities	*CTS Infused*	*MI Elements*
3. ***Additional Group Thinking Activities*** (Thinking Task Sheets for each MI group) ➢ Teacher prepares four thinking tasks for the four different MI groups. ➢ Children are to work in their respective MI groups to complete the task assigned.		
Group 1: Task sheet 1- Name and match the farm animals. Imitate the sound they made. Match them with the sounds they made. ***Thinking task*: "Why are they called farm animals?" "Where do you think you can find them?" "What can they do for human beings?"** *(Go though and evaluate the answers.)*	Interpretation Analysis Inference Evaluation	Group 1: NE
Group 2: Task sheet 2: Match the name of the farm animals in the task sheet. Name and study these animals carefully. Classify them into 2 common groups. ***Thinking task:* "Can you name and classify all these farm animals into 2 groups with some similar characteristics?"** *(Teacher/Facilitator to evaluate the grouping together with Group 2.)*	Interpretation Analysis Inference Evaluation	Group 2: LM
Group 3: Task Sheet 3: Say the names of these farm animals write their names beside them. Describe the sounds each of them made in short sentences. ***Thinking tasks*: "What are your favourite farm animals?" "Can you write simple sentences about them?"** *(Teacher/Facilitator to check through the sentences with the group.)*	Interpretation Analysis Inference Evaluation	Group 3: VL
Group 4: Task sheet 4: Name the farm animals in the task sheet. Colour them and act out the sounds they made (individually). ***Thinking task*: "Can you create a chant for the 6 farm animals?" "Can you teach (present) it to the class?"** *(Teacher to assist and evaluate the presentation of the chant).*	Interpretation Analysis Inference Evaluation	Group 4: MR/VS

Note: Each lesson was infused with the four core skills of CTS.
For every teaching activity, two to three MI based activities were implemented.
The four MI groups were formed based on the MI profile of each preschooler (as discussed in section 4.5.3).
Every teaching activity was accompanied by additional MI based thinking activities/tasks assigned to the different MI groups (4 MI groups).
Each lesson ends with a closing activity with a problem-solving task.

4.6 CTS Assessment Tools for Preschoolers

Numerous well-known assessment instruments or testing tools were developed by thinking scholars and are available commercially for assessing the skills of critical thinking for the older students or adult learners. Most of these assessments seem to overlap in a number of key themes or constructs such as reasoning, analysis, argumentation, inferring and evaluation.

For the purpose of gauging the impact of ISM (CTS infused lessons) on the teaching of CTS and the evidence of CTS development of the preschoolers, the researcher opted to conduct two CTS assessments, i.e. before and after the implementation of ISM. The general ideas for designing both the CTS assessment tools were adapted from the online model of California Critical Thinking Skills Test (CCTST) assessment instrument for K2 developed by Peter Facione and Carol Gittens (Insight Assessment, 2017).

The researcher of this study was in frequent correspondence with Carol Gittens (developer of CCTST_K2) of Insight Assessment via emails consulting and enquiring on the availability of CTS assessment tool for the preschoolers since July 2017. When the CCTST_K2 was released in September 2017 by Insight Assessment, the researcher of this study was advised to subscribe for the "trial assessment preview pack" set (online) at a nominal fee for preview purposes. The researcher went through the online assessment together with the team of preschool educators. The intention was to gauge the level of suitability of CCTST for the K2 children in Malaysia in particular, the Trinity Kids preschoolers. The researcher and the team of preschool educators (five in total) who were involved in this study went through the trial version of the CCTST_K2 testing instrument on two accounts through two online log-in identity for the test-taker provided by Insight Assessment in the form of preview purchased package.

This set of CCTST_K2 assessment tool consisted of multiple-choice items, everyday scenarios appropriate for the K2 test-takers which ranged in a few levels of difficulty and complexity. The assessment instrument included the skills of “analysis”, “interpretation”, “inferences” and “evaluation” which was to be completed between 40-45 minutes through an online access. Upon completing the CCTST for K2, Insight Assessment provided an online report of an array of scales to describe the strengths and weaknesses in the skills areas for the taker (or takers) of each round of test.

At the end of the two preview sessions of the CCTST for K2 testing instrument, the team of preschool educators found the CTS assessment was too challenging for the general six-year-old preschoolers in Malaysia setting. The followings were the feedback from the team who had gone through the preview of CCTCT_K2:

1. The team opined that the language used in general was above the proficiency level of the six-year-old children.
2. Some of the teachers involved had to read the instructions a few rounds before they were able to comprehend fully the information provided.
3. In most of the scenarios, instructions and descriptions provided were found to be too lengthy and challenging for children to understand especially the descriptions in the story forms for the third and fourth scenarios of the test.
4. In the context of synopsis and cultural background, most of the situations and scenarios (such as the four seasons of Europe countries in a year and summer break) illustrated in the test items were rather unfamiliar or may be foreign to the young preschoolers of Malaysia.

The principal and teachers also commented that they felt a sense of tension going through the assessment of twenty (20) questions within the given time frame of forty (40) minutes in an “online” format. They expressed that it would be stressful for the young preschoolers to go through the lengthy instructions or descriptions even with the teachers reading every instruction or question to them. They proposed for a hard-copy format of the assessment tool with simpler and more precise instructions or descriptions using scenarios and contexts which the Malaysian preschoolers can fathom and relate better.

Thus, the next section (4.6.1) discusses on how the researcher of this study modified and redesigned the set of CTS assessment instruments (for pre-assessment and post-assessment purposes) based on the K2-CCTST model; contextualised to the local life-style, culture and scenarios to suit the background of Malaysian preschoolers. These Preschool CTS Test (**PSCTST**) tools were provided in the hard-copy format to facilitate easier reading for the preschoolers as well as making it more feasible for easier administration by the principal and teachers of this study.

4.6.1 Designing the Preschool Critical Thinking Skills Test (PSCTST)

In line with the model of CCTST for K2, the set of PSCTST was designed in the form of multiple choices responses with well-illustrated images of various local real-life scenarios; appropriate for the six-years-old preschoolers (Carney & Levin, 2002; Dowling, 2013; Insight Assessment, 2017). All the test items were arranged and presented in a progressive manner ranging from 'simple or easy' to more 'complex or challenging'. The simpler questions required the test-taker to make accurate 'interpretation' of non-complicated information or categorization of data. Moving on to the more complex or challenging questions, the test-takers were invited to make more careful 'interpretation' of the question or image or charts, 'analyse' the information provided and to draw accurate 'inferences'. Besides, the test-takers were required to 'evaluate' the inferences or decisions warranted and to explain the reasons for those choices made. In general, test-takers are required to demonstrate their cognitive skills as well as their inclination to engage in careful thinking.

The 'PSCTST_ PRE' assessment tool was designed with multiple choice questions where most of the items were illustrated in pictorial form. This pre-assessment tool was intentionally designed to be much simpler where the clues were less complicated with simpler choices of answers as compared to the post-assessment tool. In other words, the post-assessment tool was purposefully designed with a higher level of difficulty in the aspects of scenarios descriptions, complexity of the thinking tasks and degree of challenges in the multiple choices as compared to the pre-assessment.

In principle, both the pre-assessment and post-assessment tools consist of similar scenarios, descriptions and thinking tasks but in extended levels of difficulty. For example, the questions or tasks in pre-assessment were provided with three answer choices or solutions as compared to four choices of answers in the post assessment. The content of questions and answers or solutions were presented in much simpler format in the pre-assessment tool as compared to the post-assessment tool. The descriptions of scenarios were also less complicated for the pre-assessment tool as compared to the post-assessment tool.

Both tools are further discussed in the next section of 4.6.2. in this chapter. In the process of developing the CTS assessment instruments, the researcher had considered the following practical requirements in relation to this study such as:

(1) The two sets of assessment tools (PSCTST - 'pre-assessment' and 'post-assessment') are meant to be administered before and after implementing the intervention instructional programme of ISM.

(2) It can measure value-added influence after implementing the interventional instructional programme of ISM for eight-weeks by comparing the level of CTS before and after implementation.

(3) It can be easily administered to the preschoolers by the teachers with some guidance provided such as reading through the instructions and descriptions to the preschoolers.

(4) It can measure what is intended equally, such as the four core cognitive skills of critical thinking in that the elements of all the four core skills (interpretation, analysis, inference and evaluation) are assessed in equal proportion of twenty-five percent (25%) in both the PSCTST tools.

Table 4.9 shows the allocation of twenty (20) questions adapted from CCTCT_K2 model, with four core cognitive skills being equally apportioned in the percentage of twenty-five (25%) each and a total of one hundred percent (100%). The details of scores for each question comprising either one core cognitive skill or two core cognitive skills would be described in section 4.6.3.

Table 4.9
The Apportionment of Assessment Questions Based on the Four Core Cognitive Skills of CTS in the PSCTST Adapted From CCTST_K2

Questions	***Interpretation***	***Analysis***	***Inference***	***Evaluation***	***Apportionment of Core Skills in each question***
1	√	√			0.5 x 2 = 1
2		√	√		0.5 x 2 = 1
3				√	1
4		√	√		0.5 x 2 = 1
5		√	√		0.5 x 2 = 1
6	√				1

Table 4.9 *(continued)*

Questions	***Interpretation***	***Analysis***	***Inference***	***Evaluation***	***Apportionment of Core Skills in each question***
7	√	√			0.5 x 2 = 1
8		√	√		0.5 x 2 = 1
9				√	1
10	√	√			0.5 x 2 = 1
11				√	1
12			√		1
13	√	√			0.5 x 2 = 1
14	√		√		0.5 x 2 = 1
15	√	√			0.5 x 2 = 1
16			√		1
17	√	√			0.5 x 2 = 1
18				√	1
19				√	1
20	√		√		0.5 x 2 = 1
Total	5	5	5	5	***20 Questions***
Percentage	25%	25%	25%	25%	**100%**

The score of the PSCTST would be tabulated mainly based on the constructs of the four core critical thinking skills: 'interpretation' (or categorization), 'analysis', 'inference 'and 'evaluation'. The result of the scoring is meant for the purpose of describing the levels of various cognitive skills of CTS of the test-takers in terms of strengths and weaknesses in these four categories: weak, emerging, moderate and strong through a scoring rubrics format adapted and simplified from the scale scores recommendation of Educate Insight, 2018.

4.6.2 Administering Pre-Assessment and Post-Assessment of PSCTST

Both the 'PSCTST_PRE' and 'PSCTST_POST' were administered by selected teachers of this study to the selected preschoolers. Administration of assessment tools were done on a 'one-to-one' basis within forty-five (45) minutes before and after the ISM implementation respectively. Teachers were reminded to read through the instructions or descriptions and to provide explanations for the difficult terminologies for the preschoolers.

The scores of both the PSCTST_PRE and PSCTST_POST tools were to provide informative feedback on the level of critical thinking abilities of the preschoolers before and after going through the explicit teaching of CTS via infused lessons of the ISM. The items of the PSCTST assessment tools enabled the researcher to measure the overall critical thinking abilities or traits of the selected preschoolers of this study. The researcher was also expected to use the assessment results to gauge the contribution of ISM in the development of CTS among the preschoolers. Both the 'PSCTST_PRE' and 'PSCTST_POST' assessment tools are attached as Appendixes E and F.

4.6.3 The Scoring Rubric for Pre-Assessment and Post-Assessment of PSCTST

Rubrics have been widely used by scholars as a tool for assessing students' learning and skills development (such as the skills of critical thinking), (Andrade, 2000).To answer research questions2 and 4, data were collected using the assessment tools for assessing critical thinking skills of preschoolers selected for this study. For the purpose of analysing the scores of the PSCTST tools of this study, a scoring rubric scheme was adapted from "CCTST-K2 of Educate Insight Assessment, 2018" and wasfurther modified. The scoring rubric system was prepared by the researcher in order to decipher the thinking levels of the preschoolers before and after the implementation of ISM. The scores analysis from the two assessments were used for comparison purposes.

Specifically, the scoring rubric scheme for this study was used to provide a basic indication of the level of CTS among the selected preschoolers in the category of either weak, emerging, moderate or strong measuring the four core cognitive skills which adequately reflect the potential of thinking critically as well as the critical thinking capability of the preschoolers.

A score for the level of "strong" in this PSCTST indicates that the test-taker is well capable of integrating the application of the four core skills (interpretation, analysis, inference and evaluation) for thoughtful problem solving and advanced decision making. On the other hand, attaining a low overall score or a "weak" level reflects that the test-taker has yet to achieve acceptable level of critical thinking as he or she has yet to manifest the critical thinking ability. Achieving scores in the emerging level or the moderate level of CTS in the PSCTST denotes that the test-taker has acceptable ability for thinking critically and have the potential to apply the core cognitive skills for quality solving problem and effective making decision. Table 4.10 shows the summary of the rubric scores and the general descriptions of each level of critical thinking:

Table 4.10
The Scoring Rubric for the PSCTST (Pre-assessment & Post-assessment)

Level of CTS	***Weak***	***Emerging***	***Moderate***	***Strong***
Scores	Less than 45	46-65	66-85	86 or higher
Descriptions	This result indicates that the test-taker ***failed*** to understand or relate given information or unable to draw conclusions for forming any conjectures or is unable to access the credibility of any claims made. *Test-taker is weak in most or all of the abilities above.*	This result indicates that the test-taker ***may be able to*** understand or relate some information or to draw some forms of conclusions in forming some reasonable conjectures or is able to assess the credibility of some claims made. *Test-taker is able to display some or most of the abilities above.*	This result indicates that the test-taker ***is able to*** understand and categorise most of the given information or to relate most concepts well or is able to draw accurate conclusions to make accurate predictions or is good in judging the quality of explanations given. *Test-taker is displaying most*	This result indicates that the test-taker ***is strong*** in understanding and categorising almost all the information accurately or is good in relating and use concepts for making effective decision or is able to form accurate conclusions, is able to assess and judge the

Table 4.10 *(continued)*

Level of CTS	***Weak***	***Emerging***	***Moderate***	***Strong***
Scores	Less than 45	46-65	66-85	86 or higher
	This result also indicates that the test-taker ***lacks critical thinking*** ability and may possibly be putting insufficient effort or having reading/ comprehension problem.	This result also indicates that test-taker has the ***potential for*** engaging in ***acceptable critical thinking*** or reflective decision making or problem-solving	*or all of the abilities above* This result also indicates that test-taker can ***display quality critical thinking*** and engaging in more effective decision making/ problem-solving	quality of reasoning or explanations given accurately. *Test-taker is able to display most or all of the above abilities* This result also indicates that test-taker can ***perform advance critical thinking*** and accurately making decisions and solving problems

Source: Adapted from CCTST_K2 of Educate Insight Assessment 2018

The scoring rubric system above provided an indication of the CTS level of the selected preschoolers through assessing the four core cognitive skills. As per discussed earlier in section 2.3 of this study; critical thinking operates as a whole process involving at least four core cognitive skills which are developmentally appropriate for preschoolers. In the process of preparing the scoring rubrics for analysing the data collected from the PSCTST: Pre-Assessment and Post-Assessment, the researcher took into considerations the followings:

1. The scoring rubric focused on describing the four core cognitive skills of CTS (interpretation, analysis, inference and evaluation). Each core skill was defined using primary thinking traits adapted from the definitions from APA Delphi Consensus Definition of CTS (1990), descriptions provided by Facione and Facione (1994) and Insight Assessment for K2_CCTST.

2. The scoring rubric system is used to decipher the scores obtained by the test-takers for both the pre-assessment and post-assessment of PSCTST to determine the levels of CTS. (See Appendix G for the descriptions of the four core cognitive skills, questions reflecting the core skills and percentage of sores).
3. The scores were graded based on a total of one hundred percent (100%) for the twenty questions. Each question carried five percent (5%) with either one core cognitive skill or two core cognitive skills. In the case where two core-cognitive skills were involved in a question, each skill carried two and a half percent (2.5%). For example, 'Question 3' involved only one cognitive skill of 'evaluation' which carried five percent (5%) while 'Question 1' involved two cognitive skills of interpretation and analysis (as in table 4.9) with each cognitive skill carried two and a half percent (2.5%).
4. Typically, a good rubric should have three to five levels or categories of scoring. In this scoring rubric system, the format of grading was simplified with both pre-assessment and post-assessment being graded in four (4) levels of scoring: weak, emerging, moderate and strong (discussed in section 4.6.1). The grading is based on the total percent scores as illustrated in Table 4.10.
5. The scores gathered from the scoring rubric system for each of the test-taker should be able to provide an overview of the thinking ability or the CTS level of the selected preschoolers in this study.

The scores of the selected preschoolers for both the PSCTST ('pre' and 'post' assessments) were recorded in the score sheets as in Appendixes H and I.

4.6.4 Validation of the CTS Assessment Tools (PSCTCT)

The PSCTST (Preschool Critical Thinking Skills Test) was designed and developed by the researcher of this study to measure the level of critical thinking abilities of the selected preschoolers in line with the constructs and model of CCTST_K2.

In educational studies which measuring tools or instruments are developed for data collection, validation is one of the fundamental processes to support the appropriateness or suitability of the instrument developed. For the purpose of verifying the appropriateness of PSCTST as an assessment tool for the selected preschoolers, the researcher of this study conducted an internal content validity/credibility exercise. Feedback and reviews were collected from a selected panel of experts in the early childhood education field of Malaysia and the two key aspects of verifying the content validity of this tool considered are:

1. Criteria for the selection of panel of early childhood education (ECE) experts:
   i. With qualification of a diploma or a degree in early childhood education.
   ii. Preschool teaching of more than 5 years of experience.
   iii. Preschool curriculum development of more than 5 years of experience.
   iv. Lecturer of early childhood education courses in colleges or universities (diploma, degree or master-degree levels).
   v. Early childhood academicians with expertise on researches of young children's thinking and learning.

Any early childhood educator or early childhood policy maker qualifies as a panel expert to contribute in this validation exercise upon fulfilling one or more of the above criteria. These criteria served as a standard to ensure experts selected have the capability or expertise to validate the CTS assessment instrument (PSCTST) of this study.

2. Criteria of content validation – The content validity is to assess if the testing tool can capture what it intends to measure (Insight Assessment, 2017). The validation of the content of an instrument includes items, format, instructions and descriptions, response options, the feasibility of administration and the scoring procedures. The validation exercise helps to evaluate the test items against the desired thinking outcomes. In the context of this study, the criteria of validation refer to:

    a) the level of language (English) used matches the proficiency or reading level of preschoolers: description and instructions can be understood by preschoolers

    b) items and illustrations used are suitable for preschoolers: child-like

    c) scenarios of events are contextualised to pre-schoolers' real-life background and experiences: where preschoolers can relate.

    d) thinking tasks and challenges are developmentally appropriate for the preschoolers: level of difficulty is appropriate for the six-years-old.

The content validation takes into consideration the degree of matching between the content of the assessment tool and the format of wording of items or tasks, guidelines regarding administration and scoring procedures (Chan, 2014). In the context of this study, the content validity refers to the extent of appropriate use of language level, meaningful illustrations or subjects, familiar background of scenarios and level of difficulty or challenges which are in accordance to the social environment and developmental ability of the preschoolers. The content validity of this assessment tool was further enhanced by the feedback from the selected panel of experts in the field of early childhood care and education (ECCE).

For the purpose of validating the assessment instrument of this study: a panel of eight ECE experts (as shown in Table 4.11): (A) one Principal (17 years of experience); (B) two senior preschool teachers (with above 10 years of experience); (C) two academicians from University of Malaya (experts in early childhood research), (D) two ECCE lecturers (with more than 5 years of experience) and one policy maker from Ministry of Education (with more than 10 years of experience in ECCE Sector) were selected. They were required to go through both the 'pre' and 'post' assessment tools and to provide their feedback which was documented in the feedback form (Appendix J).

Table 4.11
Panel of ECCE Experts for Validating the PSCTST Assessment Tools

	Panel Members	*Number*	*Descriptions*
A	Preschool Principal	1	17 years of experiences in teaching and managing preschool centre
B	Senior Preschool Teachers	2	More than 10 years of experiences in teaching preschool children
C	Academicians from University of Malaya	2	Experts in early childhood research
D	Lecturers (ECCE Course)	2	More than 5 years of experiences lecturing for courses in Early Childhood care and Education
E	Policy Maker (MOE-ECCE sector)	1	More than 10 years serving in Curriculum Development Division
	Total	**8**	**Experts in ECCE field**

All the eight members from the panel of ECCE experts, in general consented that both the pre-assessment and post assessment tools for PSCTST display high degree of suitability for measuring the CTS level of preschoolers

In addition, feedbacks and suggestions on the content validation from the panel of ECCE experts for both the pre-assessment tool and post-assessment tool were recorded for the purpose of further enhancing and improving the PSCTS tools. The details of the feedback are shown in Table 4.12.

Table 4.12
Content Validation for the PSCTST (pre-assessment and post-assessment) by the Eight (8) Experts of the Field

No	***Descriptions***	***Pre-Assessment***	***Post-Assessment***	***Remarks***
1.	The level of English Language used (as second language) for all the instructions and descriptions is suitable for the Malaysian preschoolers.	7/8 - yes	8/8 - yes	One of the panel members was concerned if children can understand the meaning of "logic" in question 3 while other members were confident that the test-takers are able to understand the meaning of it.
2.	The contextualization of the items, scenarios and background used for the thinking tasks is in line with the real-life environment and culture of Malaysia preschool setting.	8/8 - yes	8/8/- yes	All panels members agreed that the items, scenarios and background involved are carefully contextualised to suit the Malaysian preschool setting.
3.	The appropriateness of the level of difficulty or challenges of the thinking tasks matches the development level of the six-years-old preschoolers.	8/8 - yes	8/8 - yes	One of the panel members added the comments that these CTS assessment tools are more suitable for the 'above-average' preschoolers in the private preschools of Malaysia.

Table 4.12 *(continued)*

No	***Descriptions***	***Pre-Assessment***	***Post-Assessment***	***Remarks***
4.	This assessment tool can be easily administered to the preschoolers by the teachers with minimum guidance.	5/8 - yes	5/8 -yes	Three of the panel members felt that more than minimum guidance is required for both the assessment tools as teachers would be required to read the 'narrative' instructions to all the preschoolers and may even need to read a few times for certain questions to some of the preschoolers before they can understand the content of those questions.
5.	The overall content of this assessment tool is suitable for the preschoolers of six-years-old.	5/8-yes	8/8-yes	Three of the panel members highlighted that question 15 for the pre-assessment tool needs to provide clearer descriptions for each of the multiple choices of answers to avoid possible confusion among the young preschoolers. Rectification was made to restructure the descriptions of the multiple choices of answers for Q15.
6(a)	This assessment tool is appropriate for assessing the level of CTS of the preschoolers.	8/8- yes	N/A	All members consented that this pre-assessment tool is appropriate with one or two suggestions for improvements to be made for questions such as: Q3 & Q19 (the questions were improvised to reflect the skill of "evaluation"). Q 13 was also finetuned to provide appropriate challenges on the aspects of "interpretation" & "analysis" skills.

Table 4.12 *(continued)*

No	***Descriptions***	***Pre-Assessment***	***Post-Assessment***	***Remarks***
6(b)	There are some distinct differences between pre-assessment and post-assessment tools: the thinking tasks and problems in the post-assessment are of higher level of difficulty and more challenging for the test-takers.	N/A	8/8 - yes	All the panel members agreed that there is some good degree of differences between the two assessment tools in terms of the illustrations and presentation of thinking tasks with extra choices of answers being offered.
7.	This assessment tool is appropriate for assessing the level of CTS of the preschoolers after the implementation of ISM.	8/8	8/8 - yes	Overall, all the panel members consented that the tool, PSCTST (both pre-assessment and post-assessment) is of high degree of validity to be used for measuring the level of CTS among the selected preschoolers or test-takers.

4.7 Data Collection Techniques

This study utilized different techniques to collect data in order to answer the research questions which included classroom observations, audio and visual recording, research-generated documents, semi-structured interviews and focus-group interviews. These sources are most likely able to capture the complex aspects of the teaching and development of CTS as well as to strengthen the internal credibility of this study.

For the purpose of "triangulation", the researcher used multiple sources of data collection to cross-check the data to avoid limitations of the data collected. Besides the non-participant classroom observations by the researcher, semi-structured interviews were conducted with one Principal and three selected preschool teachers as well as focus group interviews with two groups of children (three in each group as they are young preschoolers) from one selected class of Trinity Kids Centre. Both the semi-structured interviews and focus-group interviews gathered feedback from the selected principal, teachers and preschoolers with regards to the learning activities of the ISM (infused lessons) as well as to capture their thoughts on the critical thinking tasks. The interview protocol which served as the procedural guide for directing the interview processes was used by the researcher (refer to Appendix K).

In this case study, the researcher was the sole investigator primary instrument of data collection and analysis. Prior to the class observations on the ISM implementation, the researcher visited the preschool (the site or environment) frequently to gain insights into what's going on (phenomena of study such the teaching of CTS) in the preschool classroom for the relevant data to be collected.

Other forms of data collection involved the quantitative method through administering of CTS assessment (PSCTST) to gauge the CTS levels of selected preschoolers before and after the implementation of complementary set of teaching activities as in the ISM as well as problem-solving tasks for the evidence of CTS development. These quantitative data serve as one of the multiple data collection techniques to triangulate data and to establish the validity of data in this case study.

Data collection in this case study was not done only at the 'end' of the study but on-going instead, in that while observing the implementation of infused lessons (of the ISM) in the classroom, the researcher also conducted interviews with teachers and preschoolers which compliments the observation of the present case study.

4.7.1 Classroom Observations

Classroom observations were among one of the main techniques used for collecting data in this study. The researcher attended the delivery of all the fifteen infused lesson in the selected classroom in a selected Trinity Kids Preschool centre throughout the implementation of the ISM. Besides taking field notes, the major part of the observation was documented using audio-video recording. In this context, all observations of lessons in the classroom and interviews with teachers and selected preschoolers were audio and video recorded. Audio-visual recording helped to facilitate the process of retrieving details of classroom teaching activities during data analysis.

The purpose of classroom observation was to respond to the second and third research questions. An observation protocol (Appendix L) was prepared as a guideline to assist the researcher in determining the details and data to be gathered from the all the observations. In this case study, the researcher focused on observing how the learning activities were planned and delivered through the MI approach, the participation of selected preschoolers in the learning activities, the collaborations of various MI groups in executing the thinking tasks as well as the management of problem-solving tasks.

In a non-participating observation, the researcher observed from the 'side-line' and the preschoolers were aware of being observed (Fraenkel et al., 2012). The researcher engaged herself as a non-participant observer in this exploratory case study to observe how the selected teachers deliver the learning activities planned for every infused lesson in the classroom while sitting at the back of the classroom. Due to the frequent class visits, the researcher was someone very familiar to the samplings. The selected preschoolers were able to express freely and interact comfortably during the lessons' delivery in the presence of the researcher. However, the three selected teachers were a little tense during their first two lessons delivery (for the three subjects respectively) but subsequently became more at ease after the second lesson delivery. The selected teachers and preschoolers were seen to be more comfortable as they began to get accustomed to the presence of the observer as well as the video recording of their special teaching and learning sessions. (Refer to Appendix M for the sample of observation note).

4.7.1.1 Observation Data

The observation process was basically focused on the implementation of the ISM. Prior to the class observation, the researcher explained the purpose and the schedule of the observation to the teachers and preschoolers (selected participants of this case study) to ensure all participants are aware of the presence of the researcher as the observer. Participants were encouraged to be in their usual selves, going through the implementation and participation of the teaching and learning activities in the classroom as on all other days where there was no observer around.

During the group activity sessions within the sixty minutes-lesson time, the researcher would walk to the various MI groups to observe and to listen to the discussions and suggestions of solutions within the group members. While the researcher would not be able to observe every group simultaneously, the researcher moved from group to group during the group thinking activities time and video recording randomly the discussion sessions to ensure that all the groups were observed in every lesson.

For example, in one of the thinking activities from mathematics lesson (Lesson 4), participants of all the four groups were given a task to suggest at least three ways of forming the value of 'Twelve Ringgit' (RM 12.00) with the various forms of 'toy money' (such as "toy-notes" of RM 1, RM 5, RM 10 and "toy-coins" of 50 sen, 20 sen and 10 sen) provided by the mathematics teacher. They were required to think and suggest on three different ways to form the amount of RM 12.00 with the "toy money" they had. They were to record the choice made with reasons provided before presenting the choices of combination to the class. The researcher went around to observe the groups in ‘thinking and discussing’ actions. The researcher observed that in Group 2, the LM (logical-mathematical) group; the group members enthusiastically explored the number of combinations for RM 12.00. They suggested for the following combinations:

- 1 piece of RM 10.00 toy-note + 2 pieces of RM 1.00 toy-note
- 2 pieces of RM 5.00 toy-note + 2 pieces of RM 1.00 toy-note
- 12 pieces of RM 1.00 toy-note

The members of group 2 didn’t stop at forming these three combinations, instead they made effort to explore further as they discussed in a group. The researcher observed that the facilitator was prompting the group to suggest more ideas:

Facilitator: ***Are there any more ways to make up the amount of RM12.00?***
Student 2A: *I think there are some more ways to make up 12.00 Ringgit*
Student 2B: *Yes, we still have the ‘coins’, I think we can use the ‘coins’*
Facilitator: *So, do you think you can make use of the ‘coins’ to make up the amount of 12.00 Ringgit?*
Student 2A: *Yes, I think we can.*
Student 2C: *Yes, we can.*
Student 2D: *OK, we’ll try.*
Student 2A: *I think we can use the ‘notes’ and the ‘coins’ together.*
Facilitator: *Very good, 2A. Let’s see how many more ways we can think of.*

At the end of the learning activity, Group 2 managed to form two extra combinations of RM12.00 using ‘toy-coins’ alone as well as ‘toy-coins and toy-notes’. They arranged the ‘toy-coins’ and ‘toy-notes’ in a manner of forming firstly the amount of 10.00 Ringgit followed by the amount of 2.00 Ringgit:

- 20 pieces of 50 sen ‘toy-coins’ + 10 pieces of 10 sen ‘toy-coins’
- 2 pieces of RM5.00 ‘toy-note’ + 4 pieces of 50 sen ‘toy-coins’

The perceptions and interpretation of the classroom observation data would be further verified or triangulated with the comment and feedback from the teachers (through interviews) as well as selected preschoolers (through focus group interviews).

4.7.1.2 Audio Visual Support

Throughout the observations of the implementation of the infused lessons of 'ISM', most of the teaching activities of every lesson were video recorded by researcher assisted by the Principal. The video recordings included: the set-induction, MI based teaching activities of the lessons which involved group discussions and hands-on participations as well as the closing activity which involved problem solving tasks. Audio-visual recording is very helpful for observation in this case study as it always reflects the actual scenarios or situations (Creswell, 2014) of the teaching and learning activities in the classroom.

In the observation of this case study, videos were taken to capture the behaviour of the selected preschoolers and the actual physical setting with selected segments being referred and used as supporting measure for recalling and confirming the details of the phenomenon of interest and helped the researcher in interpreting and analysing the data more accurately.

For example, during the same learning activity of the Mathematics lesson mentioned above, while the researcher observed Group 2 (LM) members executing the tasks, she could refer to the audio-visual recording to help her further understand and describe how the group executed the task of forming minimum three combinations for the amount of RM 12.00 with the 'toy-money' provided.

The next session discusses about a few other documents generated by the researcher for the purpose of collecting other data.

4.7.1.3 Research-Generated Documents

In addition to the data collected from classroom observation and audio-visual recording, four other sets of documents were generated by the researcher as the means of collecting further data for the purpose of answering research questions 2 and 4:

1. The PSCTST Assessment Tool (Pre-Assessment) (Appendix E) for assessing the level of CTS (for preschoolers) using thinking tasks with multiple choice of answers which is designed in the form of worksheet for the preschoolers. Data was recorded and tabulated through a rubric system to indicate the level of critical among the selected preschoolers. Data collected from the pre-assessment tool was analysed for answering part 1 of research question 2.
2. The PSCTT Assessment Tool (Post-Assessment) (Appendix F), was an extension of the pre-assessment tool comprised of thinking tasks with multiple choice of answers of higher degree of challenges. Data obtained from this document was analysed using the rubric system to answer question 2, part 2.
3. The MI Diagnostic (Pictorial) Tool (Appendix D) – adapted from the MI Diagnostic Tool employed by Trinity Kids since 2011 was fine-tuned for the purpose of profiling the MI strengths of the selected preschoolers of this study. The MI pictorial diagnostic tool was administered to all the twenty selected preschoolers before the implementation of ISM to facilitate the formation of the MI groups in the selected classroom.
4. Lesson Plans for ISM (Appendix C) – a set of fifteen (15) lessons infused with the four CTS core cognitive skills (interpretation, analysis, inference and evaluation). These lessons were taken and modified from the existing syllabus for three subjects: English, Mathematics and Science. Each lesson was

complemented with MI based teaching activities and group thinking tasks. The lesson plans of 'ISM' served as the compass and instructional support for the selected teachers to teach CTS to the preschoolers in the classroom.

For the purpose of validity, both the documents of PSCTST Tools were sent to eight experts in ECE field for internal validation as discussed in section 4.6.4 while the MI diagnostic tool was further validated by three ECCE curriculum experts as discussed in section 4.5.2. The lesson plans of the ISM contents were validated by seven ECCE experts as discussed in section 4.5.1 to ensure the feasibility of implementation. Table 4.13 provides a summary of the validation of all the research-generated documents.

Table 4.13
Validation of the Documents Used for Collecting Data

Documents	***Purpose***	***Validated by***
1. **PSCTST** **(Pre- and Post-)**	Assessing the level of CTS among Preschoolers before and after the ISM implementation.	• 1 policy maker from MOE (10 years of involvement with ECCE sector) • 1 Preschool Principal (17 years of experiences) • 2 Senior Preschool Teachers (10 years of experiences) • 2 Academicians from University of Malaya (experts in ECE research) • 2 Lecturers for ECCE Courses (5 years of lecturing experience)
2. **MI Diagnostic Tool**	Profiling the MI strengths of the selected preschoolers	• 2 curriculum developers for preschool education (more than 5 years experiences + MI certificate (online)_ Harvard University) • 1 Head of curriculum development department -MOE (10 years of experiences)
3. **ISM Lesson Plans**	Contents of 15 infused lesson for teaching CTS in the preschool classroom	• 1 curriculum developer with 10 years of experiences. • 1 preschool principal (17 years of experiences) • 2 Preschool class teachers (10 years of experiences) • 1 preschool subject teacher (7 years of experiences)

4.7.2 Semi-Structured Interviews of Principal and Teachers

In the context of this study, semi-structured interviews or purposeful conversations were employed to collect data for answering research questions 2 and 3. In this semi-structured interview, the researcher was the interviewer while the one selected Principal, one class teacher and two subject teachers were the interviewees. Through the format of interview, the researcher managed to obtain feedback and comments from the interviewees involved with regards to their experiences in teaching and helping selected preschoolers develop CTS in the classroom through specific questioning techniques.

The face-to-face semi-structured interviews with the selected interviewees were conducted after the implementation of ISM (infused lessons) on a one-to-one account in the Principal's office during their free periods. The interview protocol (Appendix K) which included three specific sets of open-ended questions (eleven questions) and procedures were prepared prior to the interviews being conducted. The interview protocol was designed to facilitate the process and objectives of the interview sessions. Besides taking notes, data collected from these interview sessions were video recorded to provide a more systematic manner to facilitate the transcript or triangulation process.

The interviewees for this case study were selected based on the following criteria:

1. Principal who has served in Trinity Kids for more than 10 years and is very familiar with overall Trinity Kids in-house curriculum and programme.
2. Teachers who have taught for more than five (5) years in Trinity Kids and have attended the syllabus training and training on MI approach to teaching.

3. Teachers who have taught the six years old (K2) consecutively for the past two (2) years and were familiar with the six-years-old preschoolers, the Trinity Kids in-house K2 curriculum and programme.

The experiences of the selected teachers as the interviewees of this case study were valued as teachers who were MI trained and were well-versed with the Trinity Kids Preschool (six-years-old) syllabus. Thus, they were conscious of the agenda of teaching CTS explicitly by delivering the ISM lessons (infused with CTS) through employing various MI learning activities for each of the fifteen lessons.

The protocol of the interview began with a brief explanation on the objectives of the interview by the researcher. Introduction of teachers was not necessary in this interview as researcher was familiar with the background and experiences of these selected teachers. Three main areas of probing were posted to each interviewee through ten open-ended questions for answering research questions 2 and 3:

1. Teachers' perception and thoughts on teaching CTS to young children in the preschool classroom - (interview questions 1-4).
2. Teachers' opinion on the teaching support and resources (such as ISM) required by teachers for teaching CTS to young children in the preschool classroom - (interview questions 5-8).
3. Teachers' thoughts and feedback on the teaching of infused lessons and development of CTS in relation to adopting MI approach to teaching – (interview questions 9-10).

Probes were used in between the questions in this interview to increase the richness of data by obtaining further clarification of interviewees' opinions and thoughts on the issue and support of teaching CTS through the approach of MI. For example, in the following short excerpt from the interview session with the science teacher, the researcher posted a question to the interviewee on resources required to help her teach critical thinking skills in the preschool classroom. A few probes and follow-up questions were used to obtain clearer thoughts or feedback from the interviewee on the types of resources required.

Interview:	What are the resources you required to help you teach critical thinking skills in the classroom?
Teacher F:	Ahh… resources like…materials, models, teaching aids and good activities.
Interview:	(Probe) - Do you mean, good activities as learning activities which are specifically designed for teaching critical thinking skills?
Teacher F:	Yes, the specially designed activities can 'attract' and help children learn and think. The children liked those hands-on activities that help them learn to think.
Interview:	(Probe) - Are you referring to those specifically designed activities of the infused lessons?
Teacher F:	Yes, yes… the children were asking me when they would be having the special lessons every day since we started the first infused lessons for the three subjects.

The data collected from the semi-structured interviews were recorded in the form of field-notes and audio-visual recording. The data collected was then transcribed verbatim (to keep as closely as possible to the original statements made by the interviewees) and coding was assigned to help identify common themes, categories or descriptions to reflect the emerging or overall findings. The audio-visual recording complemented the missed-out data of hand-written notes/records of the interviews. See Appendix N for the example of the transcripts of the semi-structure interviews.

4.7.3 Focus Group Interviews with Preschoolers

In this case study, the researcher conducted two sets of focus group interviews with two selected groups of children respectively after the ISM implementation. The participating preschoolers were selected based on the recommendation of their class teacher who met the criteria set by the researcher. Selection of the six-year-old preschoolers from the 'Lavender Class' for the focus group interviews was made based on the following criteria:

1. Attended the Trinity Kids Preschool (private preschool with English as the medium of delivery) for two consecutive years and have gone through Trinity Kids full-day (eight hours) preschool programmes. The full day programme is an extension of the normal (four-hours) preschool education programme which offers additional enhancement curriculum for the development of language (English in particular) skills, thinking skills, creative skills and living skills.
2. They have undergone the implementation of all the fifteen infused lessons (designed in the form of ISM) and have participated actively in all the problem-solving tasks or activities in their various MI groups to qualify them for sharing their opinions and thoughts on CTS.
3. They were proficient in English language (the second language) and were able to communicate rather fluently. They were required to be able to express their thoughts and opinions independently and confidently. Importantly, they were willing to be interviewed.

Six preschoolers who fulfilled the above three criteria were selected as candidates for two focus groups with three preschoolers in each group. These preschoolers were selected from the various MI groups: NE-1, MR/VS-1, VL-3 and LM-1.

Group 1: KidJ (VL), KidB (VL) and KidK (VL)	Group 2: KidA (NE), KidT (MR/VS) and KidN (LM)

It was a coincident that the three interviewees in Group 1 (above) were from the same VL group while interviewees of Group 2 were made up of members from mixed MI strengths. It was an observation made by the researcher that the interviewees in Group 1 were more elaborative and responsive in answering questions while group 2 required more prompts before responding and they provided briefer answers.

The two groups of preschoolers were interviewed under two separate sessions in a familiar classroom which served as a comfortable environment for the interview. The researcher began the interview by having simple chat on the ISM lessons with the two groups respectively as a warm-up session. Overall, the preschoolers responded well to the chats.

Bearing in mind that these preschoolers had short attention span and required comprehensive questions, the researcher intentionally asked simple questions carefully and clearly, guided by the questions prepared in the interview protocol for preschoolers (see Appendix O). Throughout the interview sessions, the researcher reminded the preschoolers that there were no right or wrong answers and provided gentle promptings to help them comprehend the questions before providing their opinions.

Interview questions were repeated till all three in each group provided their opinions to ensure all participants in each focus group were engaged equally. Follow-up questions and simple language were also used to guide young interviewees in expressing themselves clearer. This can be illustrated in the following excerpts of the interviews:

Researcher:	KidJ, did you enjoy the special lessons and thinking activities?
KidJ:	Yes!
Researcher:	Why?
KidJ:	Because…because the activities were fun…
Researcher:	How did you feel about the thinking activities? (Follow-up question)
KidJ:	I like them… They made me think…I like thinking because I become smart.
Researcher:	How about KidB? Did you enjoy the special lessons?
KidB:	Hmm….? Yes…. (Not too focused)

Researcher:	Why? KidJ said they were fun, how about you? (Further prompting)
KidB:	Because… ahh...they ‘are’ easy…
Researcher:	Do you mean the activities or lessons were easy? (follow-up question)
KidB:	Yes…. The activities were easy…
Researcher:	How about you, KidK?
KidK:	(Blinking his eyes) …. Umm…umm …fun and easy (very softly)
Researcher:	Do you mean the thinking activities were fun and you liked them? (Further prompting).
KidK:	Yes….
Researcher:	Were the activities easy for you that you can “complete” them? (Follow up question)
KidK:	Yes …

Transcribing the data from focus-group interviews with the preschoolers was notably more challenging as certain portions of the interviews were disrupted either by the movements or noises outside the classroom where the focus group interviews were conducted. The short attention span of young preschoolers was also one of the reasons for some portions of the interviews being interrupted and thus was unable to be transcribed verbatim. On the other hand, the audio-visual recordings were of good help to the researcher for transcribing most of the data. See Appendix P for the sample of transcription for the focus-group interview.

4.7.4 PSCTST as the Quantitative Data Collection Technique

As discussed in sections 2.9.3 and 4.7, a case study often involves a variety of data collection techniques which include both the qualitative and quantitative data. For the purpose of this study, majority of the data collected were through qualitative mode which help to address the “what” and “how” questions. On the other hand, the PSCTST Tools employed to collect the quantitative data served to complement the analysis and finding of this case study which aimed to address the “what” questions.

The tabulation of scores results of the PSCTST before and after the ISM implementation were used to compare the CTS levels of selected preschoolers in order to determine the impact of explicit teaching CTS through infusion lessons. The next section discusses on the ethical issues concerning interviewing children.

4.8 Ethical Issues

As an ethical practice, prior to the beginning of this study, the researcher sent in the research plans to be reviewed by the institutional research review board of University of Malaya Research Ethics Committee (UMREC) for approval. Upon obtaining the approval on the research ethics application from the review board, the researcher proceeded with the study plans and data collection process.

In the same manner, before employing the various data collection techniques for this study; a consent letter seeking for permission to collect data at the selected site (Trinity Kids at the School Campus) was sent to the President of the Trinity Education Group and permission was obtained (see Appendix A). With the consent obtained, only then did the researcher carry out the implementation of the intervention programme (ISM) followed by class observations.

Besides, participant information sheet (Appendix Q) and informed consent forms (Appendix R) were also sent to all the adult participants of this study such as the principal, class teacher and two subject teachers. The researcher explained the purpose and procedure of the study to the participants besides assuring them of upholding the confidentiality for all the thoughts and opinions provided. Participants of this study were also informed that they reserved the right to withdraw from the study at any time should they not feel comfortable to proceed with the interview. All adult participants involved signed and returned the form to the researcher before the interview sessions.

For the focus group interviews for this study, the researcher sent out the participant information letter and consent forms to the parents of selected preschoolers (see Appendix S). Parents of the selected preschoolers were informed of the involvement of their children in this study, providing explanation of the interview protocol. Parents were also informed that their children may pull out from the study at any time should they not be comfortable. Parents' signatures were sought as an indication of approval for their children to participate in the study prior to the focus interviews. The researcher also was committed to ensure that the privacy of each interview participant is well protected.

As a security measure for protecting the privacy of all the interviewees such as the principal, teachers and preschoolers involved, all the names referred in this study are recorded in the form of pseudonyms.

4.9 Trustworthiness of Study and Data Validation by Experts

The trustworthiness of a study has been a frequent debate among researchers and resulted in various concepts (Merriam, 2009). As such this study engaged different internal and external experts as member checks and experts' validation to review the intervention programme (example: ISM – with fifteen infused lessons), data collection tools (example: PSCTS - assessment tools and MI diagnostic tool) as well as the raw data collected from the interviews (transcript of interviews). These experts include: (A) two research supervisors, (B) one principal, (C) two senior preschool teachers, (D) two ECCE (early childhood care and education) academicians, (E) two ECCE lecturers and (F) two preschool curriculum developers, (G) one Head of Preschool Curriculum Development from MOE and (H) one policy maker from MOE (curriculum development division). The above "experts" were involved in the validation of various data resources and collection techniques for this study as shown in Table 4.14:

Table 4.14
Involvement of Various ECCE Experts in Reliability and Validity of this Study

Data Collection Sources/techniques	***Experts Involved***
1. ISM (Instruction Support Materials) - CTS Infused Lessons.	A, B, C, F
2. MI Profiling Tool for preschoolers (MI pictorial survey chart)	A, F, G
3. CTS Assessment Tools (pre and post assessment)	A, B, C, D, E, H
4. The rubric system for CTS assessment analysis (pre and post assessment)	A, D, H
5. Initial transcript of interviews	A, B, C
6. Data Analysis and findings	A, B, C

(Internal and External Validity)*:* Both the internal and external experts were asked to provide feedback and opinions upon reviewing the ISM intervention programme, CTS assessment tools, MI profiling tool and the rubric system. To add credibility to the sources of data used, these experts were encouraged to ask critical questions and examine the contents of materials or tools designed besides providing fresh perspectives and additional input to further enhance these data sources. Thus, the ISM intervention programme, CTS assessment tools and MI profiling tool were further fine-tuned and improved before implementation as per discussed after the validation exercise by the panel of ECCE experts (as in sections 4.5.1, 4.6.1 and 4.6.4).

(Member Checks)*:* The initial interview transcripts of the principal and teachers were printed and discussed with participants of interviews for further comments and verification of the inferences and interpretations made. The researcher gave a brief explanation of the purpose of checking through the transcripts to the participants concerned. However, the transcripts of focus group interviews were not checked with the preschoolers concerned as they have left the preschool and moved on for primary education in other schools. These transcripts were checked against the audio-video recording instead. After which, the interview transcripts were verified by the participants and consent was given after a few comments were made and clarifications were provided. The researcher made minor adjustment to the interview transcripts and thereafter finetuned the findings for peer review.

(Peer Review)*:* The peer review was done firstly on the ISM intervention programme which involved the principal of the selected preschool, as the study was scheduled to be conducted within the timeframe of eight weeks. Throughout the implementation of ISM (infused lessons) and class observations, the researcher discussed frequently with the principal (the peer) and made necessary adjustments based on the feedback provided with regards to the ways of conducting activities planned and preparing teaching aids to support the lessons delivery. This process helped to enhance the credibility/reliability of the intervention programme.

As an additional measure to reduce biasness on the researcher end and to enhance the dependability of the findings, the constructive challenges and critical questions put forth by the two supervisors of this study were also taken into consideration to further improve and to consolidate the finding report.

4.9.1 Data Analysis Procedure

The data analysis procedure in this case study aims to answer the research questions of this study by comparing the data collected inductively for examining the CTS development as well as to gauge the CTS level of the preschoolers before and after the implementation of ISM (the interventive CTS infused lessons) through the CTS assessments tools.

At the same time, analysing the data collected would enable the researcher to identify various emerging themes or patterns of the CTS development among the preschoolers deductively. A variety of data were collected from multiple sources adopted for the purpose of answering the respective research questions. For example, to answer research question (RQ) 3; the researcher employed data collection techniques such as classroom observation, semi-structured interview and focus group interview. The data analysis was used to describe the CTS development process among the selected preschoolers.

Figure 4.8 reflects the techniques employed for collecting the data required and the analysis of those data served to provide the insights to the findings of this research study.

Research Questions - Data Collection Techniques - Outcomes of Data Collected

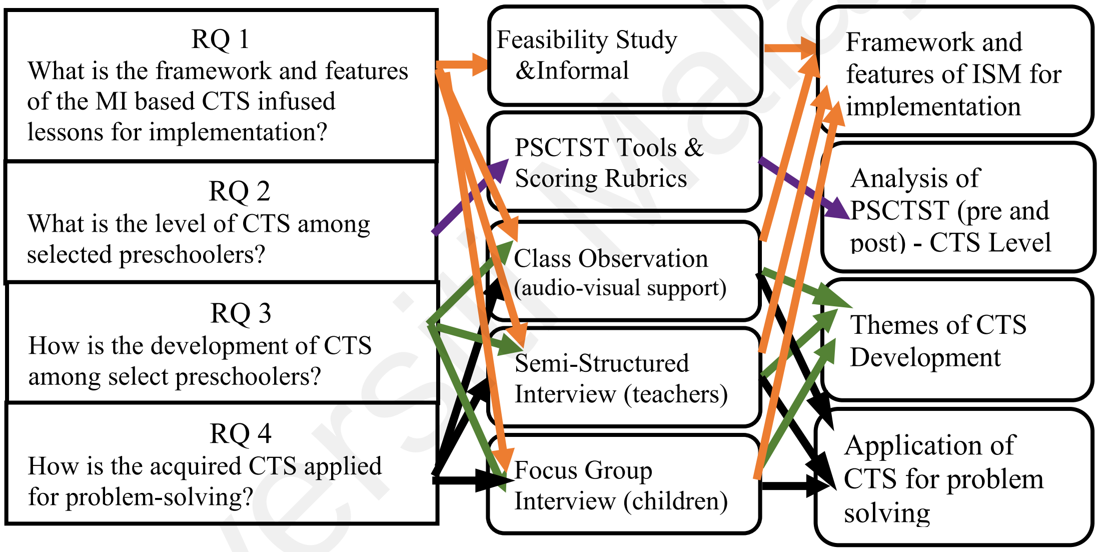


Figure 4.8 Data collection and analysis procedure for answering RQ1 – RQ4

4.9.2 Data Triangulation

As discussed in section 2.9.4, triangulation for this study involved the utilization of various main data collection methods namely, classroom observations, semi-structured interviews with selected teachers and focus group interviews with selected preschoolers. Besides, various supporting tools and documents were also used to provide clearer avenue for describing the teaching and the development of CTS.

The data collected through these few methods were 'compare and contrast' or 'triangulated' among classroom observations, semi-structured interviews (teachers) and focus-group with (students) with video recording as a support to cross-examine the data collected or analysed through these sources. The triangulation process also helped to identify the emergence of early codes and final themes of the CTS development which would be discussed in section 4.9.3 The overall data were collected and triangulated through various sources in order to answer the research questions1, 2,3 and 4 of this study as per illustrated in figure 4.9.

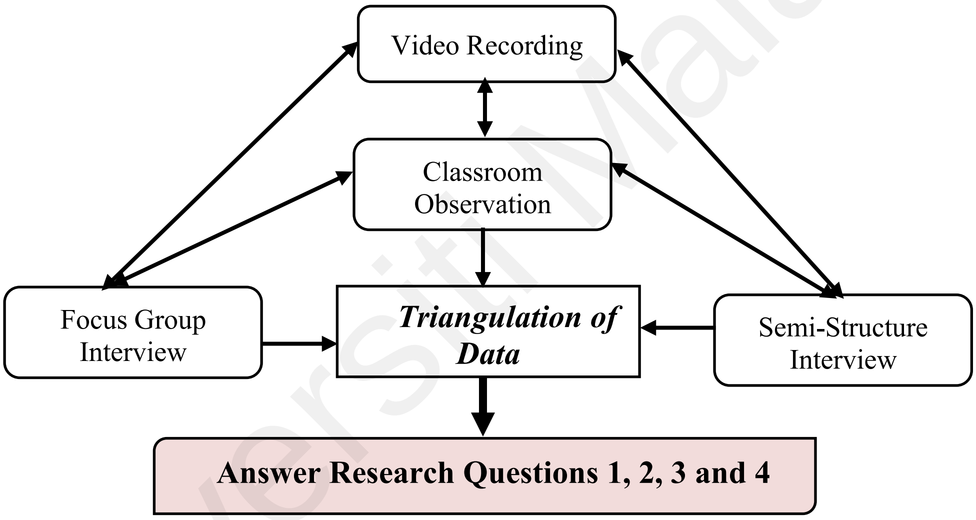


Figure 4.9 Triangulation of data collected from various sources to answer research questions 1,2,3,4.

4.9.3 Identifying Early Codes and Final Themes as Factors of Development

The cross-examination and comparison of data collected from various sources through qualitative analysis process enabled the researcher to identify various early codes to with the aim to answer question 3. The transcript of data collected from classroom observations, semi-structured interviews and focus group interviews were analysed for identifying various units of codes related to the development of CTS. The collection of codes was then categorized and sorted into themes which form the set of concept and factors to describe the process of CTS development for this study as discussed in section 2.9.3.3. Table 4.15 shows the examples of early codes identified from the various data collected.

Table 4.15
Examples of Early Codes Emerged from Analysing the Various Data Sources

Data Sources	***Example of Excerpts***	***Early Codes***
Focus Group Interview (Group 1: 22Nov2017) (Interview Protocol: Part C: 1, 2)	***Researcher:*** *Did you* ***enjoy*** *the* ***special (Infusion) lessons*** *and the thinking activities? Why?* ***KidT****: Yes. Because I can learn to think.* ***KidN****: Yes. Because I can* ***learn many things****.* ***KidA****: Yes. Because I can do (complete) the activities. I* ***know how to think***	Enjoy special lessons Thinking activities Learn to think Learn many things I Can (achievement) Know how to think
Focus Group Interview (Group 2: 23Nov2017) (Interview Protocol: Part C: 1, 2)	***Researcher****: Did you* ***enjoy*** *the* ***special (Infusion) lessons*** *and* ***thinking activities****? Why?* ***KidJ****: Yes. Because the activities were* ***fun****… They* ***made me think****. I* ***feel good*** *and I* ***feel smart*** *when I can think* ***KidB****: Yes. Because they were easy now. I* ***can do it.*** ***KidK****: Umm. Because activities were fun. I can* ***learn to think****.*	Enjoy special lessons Thinking activities Fun Made me think Feel good and smart Can do (achievement) Learn to think
Classroom Observations (Observation Protocol - Day 1- Part B -1) (10Oct2017)	*Overall, the* ***ISM*** *lessons conducted were* ***interesting****. Each infused lesson was accompanied by a wide variety of MI activities and* ***stimulating*** *thinking tasks which seemed* ***interest*** *the preschoolers in learning to think. They were* ***engaged*** *in* ***thinking activities****. They frequently asked the facilitators questions and keen to reason with their peers.*	ISM Interesting Stimulating Engaged in thinking activities
	Most of the preschoolers expressed that they ***enjoyed*** *the lessons and believed their thinking abilities have improved. They felt a* ***sense of ascendancy*** *that they have* ***learnt to think more*** *'deeply or* ***critically****' through completing the thinking tasks assigned.*	Enjoyed Sense of ascendancy (achievement) Learnt to think critically

Table 4.15 *(continued)*

Data Sources	***Example of Excerpts***	***Early Codes***
Semi-Structured Interview (Teacher M) (23Nov2017)	***Researcher***: *Do you think the complementary instructional materials are helpful in supporting the **teaching of CTS**? Why or Why not?* ***Teacher M***: *Yes. The children **enjoyed** the thinking activities. At the beginning of the first lesson, the children didn't seem to be 'thinking' much. But, after the second lesson, I could see that they **began to think more**…. At the fourth and fifth lesson, I could see that they started to **'think' more deeply** on their own and in group. The common phrase was, "I think…"*	ISM Teaching CTS Enjoyed Began to think more Think more deeply
Semi-Structured Interview (Teacher N) (23Nov2017)	***Researcher:*** *Do you think the complementary instructional materials are helpful in supporting the teaching of CTS? Why or why not?* ***Teacher N:*** *Very **helpful**. After the fifteen hours of teaching CTS through the materials, I can see which child **thinks** and which child tries to **memorise**. Many of them began to **think** instead of memorising.*	ISM Helpful Memorise Think
Semi-Structured Interview (Teacher G) (23Nov2017)	***Researcher***: *Do you think the complementary instructional materials are helpful in supporting the teaching of CTS? Why or why not?* ***Teacher G***: *Children need to be given the opportunities to learn critical thinking… like these **(infusion) lessons** … instead of the conventional ways of learning (lessons)…. children **enjoyed** the lessons. At least now they have learnt to **think deeper**.*	ISM Infusion lessons Enjoyed Think deeper
Semi-Structured Interview (Teacher F) (23Nov2017)	***Researcher:*** *Do you think the complementary instructional materials are helpful in supporting the teaching of CTS? Why or why not?* ***Teacher F:*** *Yes. Very **helpful** for the children. With the appropriate materials provided, children were able to **associate with thinking during the activities** or tasks assigned to them.*	ISM Helpful Associate with thinking
Classroom Observation (Video: English: Lesson 1-MAH 00055: 1.2 minutes) (10Oct2017)	*Children were observed to **enjoy** and were **eagerly participated** in the **MI thinking activities** specifically designed for the four MI groups. They were **working together** to arrange the sequence of numbers (0-50) using the 'Maths-Board' enthusiastically to complete the activity as a group.* *Members of various **MI groups** were **helping each other** to complete tasks through **understanding** the **information** provided.*	Enjoy Eagerly participated MI thinking activities Working together MI groups Helping each other Understanding information

Table 4.15 *(continued)*

Data Sources	***Example of Excerpts***	***Early Codes***
Classroom Observation (Video: Mathematics: Lesson 2-MAH 00098: 0.47 minutes) (17Oct2017)	*During **MI Group/Thinking Activities** 2: Children in various MI group were observed to **readily discuss** and **put ideas together** to complete the respective **thinking tasks** (MI based) assigned. They were seen **working together** in **collaboration** and deliberated the suggestions put forth by **peers** before 'deciding' how to complete the tasks on various hobbies. Teachers were seen **providing guidance** and asking for more ideas, "Can you think of **more ideas**?"*	MI group Readily discuss Put ideas together Thinking tasks (MI based) Collaboration Peers Providing guidance More ideas
Classroom Observation (Video: Science: Lesson 2-MAH 00127: 3.5 minutes) (10Oct2017)	*MI Group/**Thinking Activities** 1: Children in various **MI groups** were observed to be **readily engaged** in discussions (example: **inferences** and outcomes of the experiments on substances which dissolve or not dissolved. They **discussed among peers** and with **teachers** before confirming the answers. Children in various groups seemed to **work well together**. Teachers of various groups were **assisting children** with the experiments.*	Thinking activities MI groups Readily engaged Inferences Discuss among peers and teachers Worked well together Assisting children
Semi Structured Interview (Teacher M) (23Nov2017)	***Researcher**: Do you think pre-schoolers should be taught CTS in the classroom? How?* ***Teacher M**: Yes. I observed that children when **discussed in groups** on the answers they think, they '**reasoned**' and '**argued**' with their friends. They need to be **guided** on how to think critically. They need to learn to **analyse and support** their own answers or solutions and not just follow their friends' answers. Some of them would rethink and checked their answers again until they got the solutions. We need to give them the **opportunities** to think more in-depth (critically) like thinking tasks.*	Teaching CTS-How Discussed in groups Reasoned & argued Guided Analysed and support one's answers Opportunities to think more in-depth
Semi Structured Interview (Teacher N) (23Nov2017)	***Researcher**: Do you think preschoolers should be taught CTS in the classroom? How?* ***Teacher N**: Yes. The children required the teachers to guide them and maybe like **provide some steps** on how to think (critically), **some prompting questions** or **some ways** on how to think deeper. They need to learn about checking on the information, understand them and revisit the information while they worked on the solutions together. We could see this during the '**infusion lessons**', children got **the chance to think** more in-depth with the thinking activities.*	Teaching CTS-How Provide some steps Some prompting questions or guide Think deeper Infusion lessons The chance to think more in-depth

The early codes listed in Table 4.15 were then sorted and condensed into various categories or themes which were used to reflect the factors contributing to the CTS development process among selected preschoolers in Trinity Kids. The categorization of themes was used to describe the factors which contribute to the process of CTS development of selected preschoolers. This is illustrated in table 4.16 and would be discussed in chapter 6.

Table 4.16
The Early Codes and Final Themes from Various sources of Data

Example of Sources	***Early Codes***	***Themes Generated***	***Final Themes***
Focus Group Interview (Group 1: 22Nov2017) (Interview Protocol: Part C: 1, 2)	Enjoy special lesson Thinking activities Learn to think Learn many things Eagerly participated Know how to think	• Enjoy special lessons • Eagerly participated • Feel good to be able to think	• Enthusiastic about learning to think (***positive attitude towards critical thinking***)
Focus Group Interview (Group 2: 23Nov2017) (Interview Protocol: Part C: 1, 2)	Enjoy special lessons Thinking activities Fun Made me think Feel good and smart Can do (achievement) Learn to think	• Learn to think • Sense of achievement-able to think	• Infusion lessons (explicit teaching and learning of CTS)
Classroom Observations (Observation Protocol - Day 1- Part B -1) (10Oct2017)	ISM Interesting Stimulating Enthusiastic Eagerly participate Readily engaged Enjoy Sense of ascendancy (achievement) Learnt to think critically	• ISM (Lessons) were interesting and stimulating • Children were enthusiastic and readily engaged and enjoyed thinking • Sense of achievement – learn to think critically	• Enthusiastic – enjoy/engaged in learning to think (***positive attitude towards critical thinking***) • Infusion lessons (ISM) – (***explicit teaching and learning of CTS***)

Table 4.16 *(continued)*

Example of Sources	***Early Codes***	***Themes Generated***	***Final Themes***
Semi-Structured Interview (Teacher M) (23Nov2017) Semi-Structured Interview (Teacher N) (23Nov2017) Semi-Structured Interview (Teacher G) (23Nov2017) Semi-Structured Interview (Teacher F) (23Nov2017)	ISM Teaching CTS Enjoyed Began to think more Think more deeply ISM Helpful Memorise Think ISM Infusion lessons Enjoyed Think deeper ISM Infusion lessons Enjoyed Think deeper	• ISM for teaching CTS • Children enjoyed infusion lessons • Children began to think more critically Thinking versus memorizing	• Infusion lessons_(ISM) (***explicit teaching and learning of CTS***)
Classroom Observation (Mathematics: Lesson 1- MAH) (9am – 10am) (10Oct2017)	Enjoy Engaged MI thinking activities Working together MI groups Helping each other Understanding information	• Worked together in MI groups • Helping each other • Understand information	• ***Collaborative of strengths through MI group activities***
Classroom Observation (English: Lesson 1) (11am - 12 noon) (10Oct2017) Classroom Observation (Science: Lesson 2) (1 pm – 2 pm) (2Nov2017)	MI group Discuss Put ideas together Thinking tasks (MI based) Collaboration Peers Providing guidance Thinking activities MI groups Engaged Inferences Discuss among peers and teachers Worked well together Assisting children	• Discussing and putting ideas together • Working together and collaboration with peers • Teachers providing guidance/assistanc e • Worked well together	• Peers' Collaboration and Teachers' Support (***Scaffolding for critical thinking***)

Table 4.16 *(continued)*

Example of Sources	***Early Codes***	***Themes Generated***	***Final Themes***
Classroom Observation (Observation Protocol: Lessons 4-5: Part F- 2) (2Nov - 9Nov2017)	Teachers' questions Consistently Open-ended questions Enthusiastically Suggesting ideas Posing questions Structured pattern Routine Understand (Interpretation) Gather from the information (Analyse) Suggest how to (Inference) Are there other ways (Evaluation) Questions routine Guided manner	• Consistent/Structured pattern of questioning • Open-ended questions • Core cognitive skills of CT (interpretation, analyse, inference and evaluation) • Question and answer routine	Questioning techniques & thinking routines (***thinking routines***)
Semi Structured Interview (Teacher M) (23Nov2017)	Teaching CTS-How Discussed in groups Reasoned & argued Guided Analysed and support own answers Opportunities to think deeper	• Providing deeper thinking opportunities • Providing guidance and ways for thinking deeper	• Classroom climate for in-depth thinking (***classroom climate for challenging critical thinking***)
Semi Structured Interview (Teacher N) (23Nov2017)	Teaching CTS-How? Provide some steps Some guide or ways Infusion lessons The chance to think more in-depth	• Reasoned and argued to support decisions made • Think more in-depth	

From the analysis and categorization of early codes and themes generated, six final themes were established as factors which contributed to development of CTS as the finding for answering research question 3:

(1) ***readiness towards critical thinking*** (readily engaged and enthusiasm for thinking critically),

(2) ***explicit teaching and learning to think critically*** (infusion lessons in the form of ISM),

(3) ***scaffolding for critical thinking*** (collaboration from peers and support from teachers),

(4) ***routines for critical thinking*** (consistent pattern of thinking leading to critical thinking).

(5) ***classroom climate for challenging critical thinking*** (environment created for more in-depth thinking) and

(6) ***collaborative of strengths*** (effective learning and thinking through MI based activities).

4.10 Summary of Chapter

This present study provided descriptions of the procedures involved such as the feasibility study and the preparation stages as well as the data collection techniques at the selected preschool centre. This study also further described the inductive analysis of the data collected from respective sources to generate general codes and themes as the researcher made interpretation of the data and analyse those data before reporting on the conclusions based on the findings of this study.

This chapter explains the research design as an embedded single case for this study and provides justification for selecting the particular site (Trinity Kids) and samples (the six-years-old preschoolers from Trinity Kids) for this study.

Procedures of study stretches from feasibility study to preparation and implementation of ISM (Instructional Support Materials) was described. Various strategies employed to facilitate the gathering of data such as class observations, semi-structured interviews and focus group interviews were also discussed.

Methodologies involving the teaching of CTS through infusion approach and teaching pedagogy based upon the theory of multiple intelligences were also described.

Besides, various methods for triangulating the analysis of data collected and findings of study such as internal validity or cross-examination, member checks and peers review with the participants of this study were articulated.

In the next chapter, the researcher will describe the preparation and implementation processes of ISM through analysing the data collected from class observations, semi-structure interviews and focus group interviews.

CHAPTER 5

THE INSTRUCTIONAL SUPPORT MATERIALS (ISM), IMPLEMENTATION AND CTS LEVELS

5.1 Introduction

This chapter discusses the findings of the established framework for ISM in answering RQ 1. The ISM comprised of CTS infused lessons for teaching CTS explicitly through adopting the MI based activities in the selected preschool classroom. This chapter describes how ISM's framework was constructed for developing the support materials to enable selected teachers teach CTS in the selected preschool classroom. The framework of ISM, the implementation of ISM as well as the comparison of CTS levels before and after the implementation to gauge the CTS development among selected preschoolers would be described further in sections 5.3 and 5.4 respectively.

5.2 The Framework of ISM

The ISM served as the intervention instructional support for the selected preschool teachers to teach CTS in their classroom. The four sessions of deliberations with ECCE experts (two preschool curriculum developers, one principal and two senior preschool teachers) at Trinity Kids selected preschool centre provided the basis for drawing up the framework for infusing CTS into ISM. Besides the infused CTS, the contents of ISM were planned in line with three other essential considerations: (1) Number of infusion lessons for the three subjects, (2) MI based activities and (3) Trinity Kids existing curriculum for the six-year-old (K2).

Through the discussion sessions, the team of experts (as in Table 4.3) provided valuable input and suggestions to the researcher on how to infuse the selected four core cognitive skills into existing lessons. Based on the input provided, the researcher was able to incorporate the four core skills (interpretation, analysis, inference, evaluation) into every lesson of the ISM set in the form of group thinking activities.

The initial two discussions deliberated on the features of ISM to ensure sufficient hours of learning were allocated for teaching the four core cognitive skills across the three subjects. As a result, fifteen lessons of one hour each was planned with the four core cognitive skills being incorporated into the teaching activities of five lessons for each of the three subjects (English, Mathematics and Science).

The team of experts also deliberated on how each teaching presentation could be supported by three to four MI based activities (as discussed in section 4.5.5) as an integral part of the framework. This was to ensure that selected preschoolers were given the opportunities to learn from various modalities that were of preference to them. The team also advised that grouping of children according to the various MI strengths through profiling their MI strengths would further support effective learning and development of CTS among selected preschoolers.

In addition, the framework included the group thinking activities (addressing the social constructivism aspect of CTS development) and problem-solving tasks (addressing the cognitive constructivism aspect of CTS development) to provide more in-depth thinking opportunities and practices for the selected preschoolers. The framework of the ISM is illustrated in Figure 5.1 below. The framework of ISM provided the researcher the direction for establishing the CTS infused contents and designing the specific MI instructional strategy (such as MI based activities, MI profiles and MI groupings) for teaching CTS explicitly to the selected preschoolers. The framework of ISM established for this study would consistently form the backbone of all the fifteen infusion lessons delivery. The establishing of the elements of the ISM framework would be discussed in the next section.

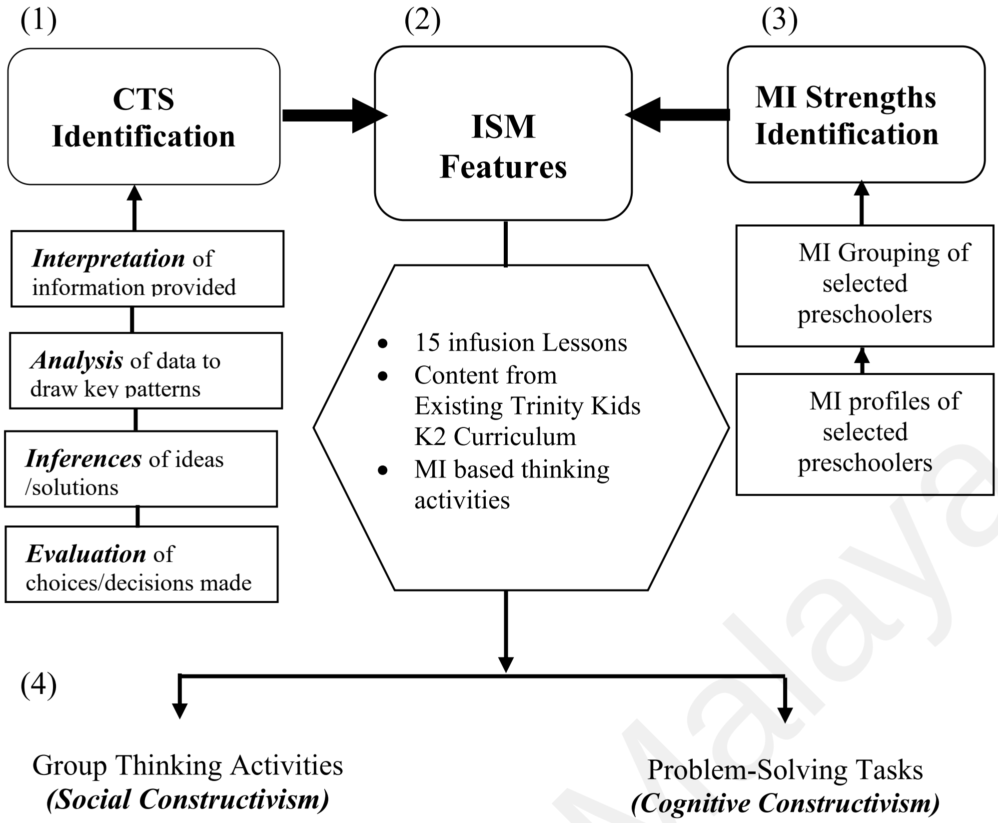


Figure 5.1 Framework of ISM Preparation for Implementation

5.2.1 Elements of ISM Framework

With the data and input gathered from the discussions with the panel of ECCE (mentioned in section 5.2 above), the following elements of ISM framework (illustrated in Figure 5.1 below):

(1) ***The identification of the core cognitive skills of critical thinking***

In the context of the framework drawn up above (Figure 5.1), the four-selected core CTS, namely 'interpretation', 'analysis', 'inference' and 'explanation' were based on the six core cognitive skills as per APA Delphi Report's consensus definition of CTS (Facione, 1990). These four core cognitive skills of critical thinking were identified as they were deemed developmentally appropriate for the six-year-old preschoolers by the thinking experts (Nicoll, 1996; Educate Insight, 2018). The four core cognitive skills were infused into existing lessons of the three subjects from Trinity Kids _ K2 Curriculum: English, Mathematics and Science in the forms of thinking activities and problems solving tasks which promote critical thinking in the aspects of:

i. Interpretation or understanding of requirement of questions/problems and information provided.
ii. Analyse or examine the data/information provided to look for key patterns.
iii. Drawing of ideas or inferences from data or key patterns identified as solutions.
iv. Evaluate or justify the choices of solutions or decisions made.

These four core skills were consistently promoted in each lesson (of the ISM) to provide selected preschoolers the opportunities to learn and practice critical thinking as in the group thinking activities. These thinking activities allowed children to practice or apply CTS through solving the tasks or problems assigned.

(2) ***Features of Infusion Lessons***

i. The fifteen (15) infusion lessons were prepared based on the Swartz' and Parks' infusion approach (as discussed in sections 3.51 and 3.5.2) with the CTS being integrated into the content of existing curriculum. Each ISM lesson was supported by a detailed lesson plan comprised of a 'set induction', two 'MI based teaching-learning activities' and a closing activity.
ii. The contents of ISM were based on the existing syllabi of the preschool curriculum developed for the six-years-old by Trinity Kids. In other words, the contents were taken from the existing teaching and learning

materials of Trinity Kids. The infusion lessons were planned in accordance to the five topics (of the three subjects) stipulated for weeks 40-47 of the current academic year of Trinity Kids as was discussed in section 3.5.2.

iii. For every CTS infused lesson, MI based teaching and thinking activities were employed for the delivery. Every lesson was delivered through two main teaching-learning activities incorporated with MI activities. In other words, every teaching activity was designed with three or four MI strengths or elements to address all the eight areas of intelligences and learning preferences of the preschoolers. For example, for a teaching activity which employed a ‘language song’ on various types of wild animal’; the MI elements involved are: MR, VL and NE. Figure 5.2 illustrates the infusion lessons of the ISM.

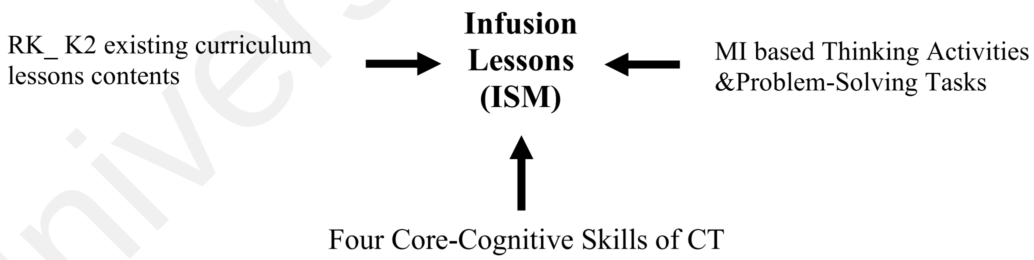


Figure 5.2 The Infusion Lessons of the ISM

(3) ***Identifying the MI Strengths***

In the context of this study, the ISM implementation is supported by the MI instructional approach. To enable the MI approach or strategy for teaching CTS explicitly and effectively, the planning of ISM framework took into considerations the identification of MI strengths which involved the MI profiling of the selected preschoolers. The formation of various MI groupings for the selected preschoolers was based on the tabulation of the MI strengths of each selected preschooler at the end of the profiling survey. The details of MI profiling and MI groups formation were discussed in sections 4.5.3 and 4.5.4.

In this study, the MI strengths of all the twenty selected preschoolers were profiled using the pictorial MI survey adapted from Trinity Kids MI diagnostic tool. The profiles of the selected preschoolers were analysed and four MI groups (NE, LM, VL and VS+MR) were formed for the purposed of this study. Each MI group was in turn facilitated by one teacher/facilitator during the execution of thinking activities or problem-solving tasks.

The MI strengths identification (based on MI theory) serves to facilitate and enhance the implementation of the infusion lessons from the ISM set as illustrated in Figure 5.3. The implementation of ISM in relation to children's MI strengths would be discussed in section 5.3.

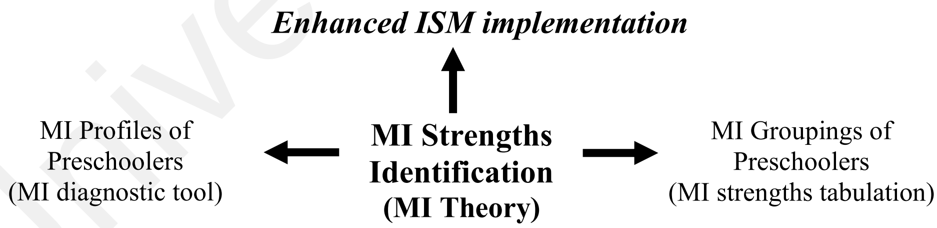


Figure 5.3 The MI strengths identification- enhances ISM implementation

(4) ***Group Thinking Activities and Problem-Solving Tasks***

Two other important elements of this ISM framework include the thinking activities and problem-solving tasks which were specifically designed for provoking in-depth thinking and for promoting critical thinking among the preschoolers (Figure 5.4). The group thinking activities encouraged children to collaborate and work together while provoking deeper thinking through discussions in accomplishing the tasks as a group. The collaboration for completing the group thinking activities depicted the aspect of Vygotsky's social constructivism which was believed to have scaffolded the development of CTS among the preschoolers.

On the other hand, the problem-solving tasks provided at the end of every infusion lesson, engaged children in reflective and purposeful thinking while working on the solutions. The assimilation of the new information into their existing thinking and reconstructing their thinking to accommodate the new data were related to Piaget's cognitive constructivism of the CTS development. In other words, under the ISM framework, thinking activities were designed and implemented as the MI group activities while problem-solving tasks were designed and implemented as the closing activities in all the infusion lessons. The implementation of ISM would be discussed in the next section.

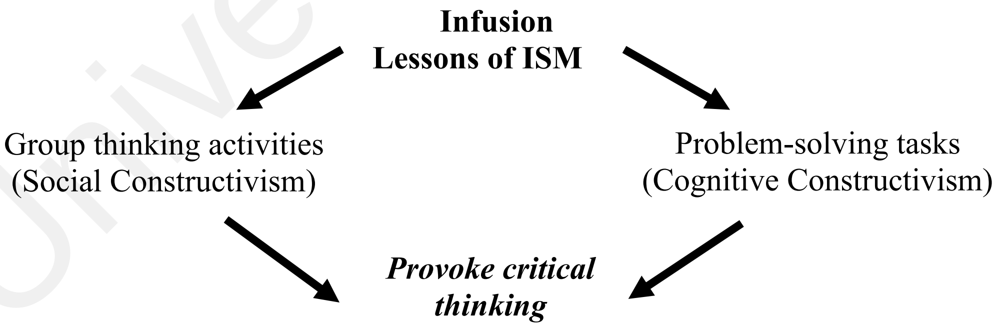


Figure 5.4 Group Thinking Activities and Problem-Solving Tasks provoke critical thinking

In summary, the framework of ISM was established based on the four elements of CTS identification, MI strengths identifications, main features of ISM as well as the both the social and cognitive constructivism aspects of learning for the purpose of teaching CTS explicitly to preschoolers. The next section discusses on the implementation of ISM in the selected preschool classroom.

5.3 Implementation of ISM in the Selected Preschool Classroom

Taggart et al. (2015) and McGuiness et al. (2017) attest that CTS infused lessons were effective for teaching CTS to preschoolers. The researcher observed the delivery of all the fifteen infusion lessons. It was observed that the implementation of first two lessons had minor challenges as teachers and children in the selected preschool classroom were still adapting to the presence of the researcher as the non-participating observer. The data from the classroom observations summary revealed that the preschoolers enjoyed almost all the infusion lessons of the ISM set. Table 5.1 is a summary record of the observations:

Table 5.1
Summary Record of the Classroom Observations on the Implementation of ISM

Areas of Observations	***Descriptions of Observations***
1. Learning Environment (Part A: 1, 2, 3 of observation protocol)	1. Classroom was conducive, well-decorated and spacious enough for various thinking activities to be conducted in the four MI groups. 2. Well lay-out of furniture and group settings provided pleasant learning environment for the four MI groups. Children seemed to enjoy the lessons and were comfortable with carrying out the thinking activities or group tasks in the spacious room.
2. Infusion Lessons (Part B: 1, 2 of observation protocol)	1. Each lesson began with a well-thought of activity as a prelude to the actual lesson, stimulating the interest of preschoolers towards learning, more specifically, thinking. 2. Teacher frequently posed questions that lead to the key points of the lesson while students would pause to 'think' before responding. 3. Teaching activities included: video clips, singing, nursery rhymes, magic show, role-play, guessing games, real objects and puzzles (For example: English-Lesson 1: A YouTube video clip on SEA Games was used for introducing the lessons on sports and hobbies). Children enjoyed these stimuli as they engaged themselves with the 'thinking involvement'.

Table 5.1 *(continued)*

Areas of Observations	***Descriptions of Observations***
3. Classroom Management (Part D: 2, 3, 4 of observation protocol)	1. The arrangement of having a well-experienced teacher for each MI group (with 4-6 children) was a great advantage in ensuring that all MI based activities were well-implemented at all the four MI groups. While a teacher (either the class teacher or subject teacher) was delivering a lesson, there were three other teachers assisting the class of twenty preschoolers. 2. Selected teachers were seen able to manage adeptly a wide variety of thinking activities for the various MI groups which were implemented concurrently. For example, Mathematics_ Lesson 1: Comparison of numbers 1-50, while Group 1 (NE/INTER/BK) was creating a number line using recycled materials such as egg carton, Group 2 (LM/INTER/BK) was creating a number line by arranging number-cubes onto the 'Maths-board'. As Group 3 (VL/INTER/BK) was spelling and writing in words for the numbers picked from the number-line; Group 4 (MR/VS/INTRA/BK) was creating and drawing the number line frames. 3. Throughout the execution of the various teaching and thinking activities, the preschoolers were greatly engaged. They displayed enthusiasm in participating and completing the thinking activities/tasks assigned to them in their respective MI groups. This observation was assented by the semi-structured interviews.
3. Overall Observation (Part F: 1, 2 of observation protocol)	1. Overall, the ISM lessons conducted were interesting. Each infused lesson was accompanied by a wide variety of MI activities and stimulating thinking tasks which seemed to captivate the interest of the preschoolers in learning to think. 2. The preschoolers were able to execute and complete the group thinking tasks confidently with the guidance from the experienced facilitators/ teachers. 3. Most of the preschoolers expressed that they enjoyed the lessons and believed their thinking abilities have improved. They felt a sense of ascendancy that they have learnt to think more 'deeply or critically'. The same expression was articulated by the preschoolers in the focus group interviews.

On the same note, all the six selected pre-schoolers from the focus group interview also expressed that they enjoyed all the ISM learning activities which were rather different from other earlier lessons. The selected preschoolers particularly enjoyed those specially designed set inductions (such as the video clips, magic show, guessing games), group thinking activities (which they worked together to accomplish the thinking tasks assigned) and the problem-solving tasks (which they discussed together for solutions). They expressed that they enjoyed 'thinking' and 'felt smart' for being able to 'think'. The excerpt below depicts the expressions of the selected preschoolers.

Interviewer: *Why did you enjoy the special lessons and thinking activities?*
KidJ: *I can learn and think.*
KidA: *I can do the activities and (I feel) I am good (smart) because I know how to think.*
KidN: *I liked the science activities (experiments). I liked to think for myself to find the answers.*
KidJ: *They were fun. They were different from the lessons/activities before. I felt good to be able to think more.*
KidB: *The activities were 'easy' and I can 'do it' (accomplish them).*
KidK: *They were fun. They were not the same 'like' (as) before… there were more thinking to do…*
(Focus Group Interview, 23/11/2017)

In the same manner, the teachers involved in this study further consented that the ISM lessons were interesting and the preschoolers enjoyed the lessons particularly so with the teaching activities and thinking tasks. The selected teachers commented that the preschoolers began to 'practise' CTS in numerous scenarios and during lessons of other subjects such as character building, reading and culinary. The excerpts of semi-structured interview (dated 23 November 2017) conducted with the teachers and principal below supported the classroom observation report (See Chapter 5, Table 5.1) of the researcher.

Interviewer: *Do you think the ISM are helpful in supporting the teaching of CTS?*
Teacher N: *Yes, definitely. The lessons were very **interesting** for the children. They enjoyed the lessons very much and they became habitual in using the phrase "I think…" even during other lessons.*
Teacher F: *The materials provided helped a lot. The children **enjoyed** the lessons. The classroom setting is well prepared and **conducive** for them and they looked forward to the next special (ISM) lesson.*
Teacher M: *I find the ISM lessons very stimulating and helpful for teaching the CTS in a more conscious (explicit) manner. The children thought that they have become smarter now because they believed they have learnt to 'think' more.*

Teacher G: *I liked the ISM lessons myself. The teachers were well-experience and they delivered the lessons well. I'm happy to see that children enjoyed learning to think and participated eagerly. I hope the teaching of CTS can be included in our curriculum.*

Thinking experts claim that infusion of contents and instruction of thinking skills which are well organised have an effective impact on teaching CTS explicitly to young learners (Davis-Seaver, 2000; Lai, 2011; Taggart et al., 2005).This suggests that explicit teaching of CTS can be achieved through the effective implementation of the well-organised infusion lessons or ISM as per the infusion approach proposed by Swartz & Parks (1994).

The data collected from observation (See Table 5.1 - Observation Summary: Parts A, B, D and F), semi-structured interviews and focus group interviews indicated that the ISM implementation has a positive influence on the learning and development of CTS among the preschoolers. It was observed that selected preschoolers were more engaged with learning and practising CTS during the ISM implementation. In this context, the researcher found that the implementation of ISM was carried out well in the selected preschool classroom. Based on the analysis of the various data collected, the implementation of ISM was well-supported by the following factors:

1. ***Positive and conducive learning environment*** provided the pleasant learning platform which helped to promote the development of critical thinking among the preschoolers in the selected classroom. The preschoolers were found to be at ease and readily engaged in all the thinking activities. The conducive environment provided preschoolers the comfortable space for them to brainstorm and discuss about the thinking activities in various groups. (See Table 5.1: Observation Summary- Part A: 1, 2, 3) and Semi-structure Interview of Teacher Farah.

2. ***Teachers were well-experienced and well-trained*** to deliver a wide variety of MI based thinking activities to meet the objectives of each ISM lesson. The selected teachers were also well prepared with all the necessary materials for each lesson and were seen to have implemented MI based activities well. The well delivery of ISM lessons was believed to have led to enjoyable learning and thinking experiences for the preschoolers. The experienced teachers were also observed to have provided encouragement and support for children in various groups to think more in-depth by prompting them with specific questions (Table 5.1: Observation Summary- Part D: 2, 3, 4). This concurred with the observation made by Teacher G.

> *"… The teachers were well-experience and they delivered the lessons well. I'm happy to see that children enjoyed learning to think and participated eagerly…*" (Teacher G, Interview, 23/11/ 2017.

3. ***Interesting and stimulating thinking activities/tasks*** planned for each CTS infused lesson were observed to have captured the interest of preschoolers. The thinking tasks or activities of the infusion lessons created the context and opportunities which were stimulating for the preschoolers to utilise their CTS. This was reflected in the way they claimed that they were smarter as they have learnt to 'think' and they valued their new-found abilities to think more in-depth (Observation Summary- Part B: 1, 2). In relation to this, Teacher M made the similar remarks while KidJ articulated that the activities stimulated him to think and that he felt smarter when he has learnt to think. The excerpts below reflect the remarks of Teacher M and KidJ:

> *"...I find the ISM lessons very stimulating and helpful for teaching the CTS in a more conscious (explicit) manner…" (*Teacher M, Interview, 23/11/2017)

> *"... The activities were fun, they made me think. I feel good and smart when I can think."* (KidJ, Focus Group Interview, 22/11/2017).

The effective implementation of ISM lessons by the experienced teachers appeared to have stimulated the learning of CTS and impacted the CTS development among the selected preschoolers. Teacher M reported that these preschoolers were found using the phrase "I think …" more frequently and naturally while participating in the group discussions as illustrated in the excerpt below (See also Chapter4, Table 4.15).

> *"…At the fourth and fifth lesson, I could see that they started to 'think' more deeply on their own and in group. The common phrase was, "I think…"* (Teacher M, Interview, 23/11/2017)

In addition, through the analysis of the various data; several factors were found to have contributed to the effective implementation of ISM. The effective implementation of ISM is observed to have a positive impact on the development of CTS among the preschoolers in the selected preschool classroom. This finding concurred with the studies by scholars such as (Asaaf, 2009; Aizikovitsh & Amit, 2010; Lin, 2014) that the implementation of infusion lessons has accelerated the CTS development of learners. Figure 5.5 below illustrates those factors involved contributing to the effective implementation of ISM and its impact on the CTS development of selected preschoolers.

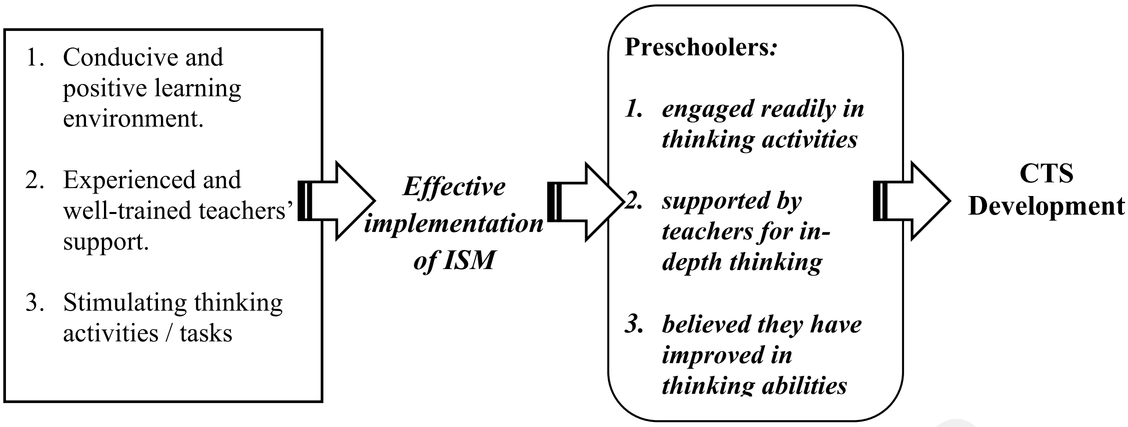


Figure 5.5 Effective implementation of ISM benefitted the CTS development of preschoolers.

5.3.1 Implementing ISM through MI Approach

Exploring how CTS can be taught explicitly and effectively to the selected preschoolers through the MI instruction strategy is the focus of this study. The classroom observations throughout the implementation of ISM served as useful data for describing the MI approach as an instructional strategy for teaching CTS in the selected preschool classroom. The analysis of an excerpt from the summary of observations protocol (Part C:1, 2 and 3) as in table 5.2 as well as an excerpt from semi-structured interviews with selected teachers provided the insights on the teaching process of the ISM implementation. The analysis was supported by the review of the video recordings.

Table 5.2

The Summary Descriptions of Observations on the MI Approach for Teaching CTS Through the Implementation of ISM

1. Implementation of MI approach for conducting the lesson (Observation Protocol: Part C: 1, 2, 3)	1. Selected preschoolers were placed in four (4) main MI groups in accordance to their MI strengths after the MI diagnostics test conducted by their teachers. The preschoolers seemed to interpret the task requirement and analyse the information better in their respective MI groups as they worked together to solve the thinking tasks in the same group. 2. Each MI group of 4-6 preschoolers was facilitated by a teacher whose MI strengths correspond to the proclivities of the MI groups assigned. The teachers were observed to have interacted very well while providing supports and guidance to the respective groups. 3. Each lesson was delivered through three main teaching activities (besides 'set-induction' and 'closing') and was supported by three to four MI based thinking activities to provide learning activities preferred by each MI group. 4. The MI based thinking activities were purposefully designed for the various MI groups. Example: ***Group 1 (NE/INTER/BK)*** – focused on activities related to nature and environment (such as: animals, plants and environment such as park, farm, jungle and sea); ***Group 2 (LM/INTER/BK)*** - focused on activities which were logical, analytical and mathematical (such as: counting and classification of animals, number lines, chart or graph on objects) ***Group 3 (VL/INTER/BK)*** – focused on activities related to words or languages (such as: short stories, written/verbal descriptions, brainstorming and writing of sentences or short paragraphs); ***Group 4 (MR&VS/INTRA/BK)*** – focused on activities related to musical, visual, creativity and intrapersonal (such as: rhythm, raps, songs, chants, drawing, colouring, designing and graphic). 5. Overall, for each ISM lesson, selected teaches were well-prepared with wider range of MI activities and materials to support the learning of thinking skills. Children in various MI groups were seen to have enjoyed working together in collaboration while going through the discussions and deliberating on ways and suggestions for completing and solving the thinking tasks.

In the context of this study, the MI instructional approach referred to the teaching of CTS through MI based teaching activities and thinking tasks which allowed a wider range of stimulating thinking experiences for the preschoolers. In other words, each of these activities was carefully designed to incorporate three or more intelligences (MI). This concurs with the claim made by Metha (2002), that focusing on the strengths of the children gives them the motivation and opportunity to learn in the ways that they learn best. In the same context, this applies to the learning of critical thinking skills.

A teaching or thinking activity can be presented in various forms of MI based activities such as dramatization, experiment, guessing games, matching, collecting samples, and rhymes to address various areas of MI. For example, teaching activity presented through dramatizing a story helps to address verbal-linguistics (VL- dialogues of spoken lines of the story), interpersonal (INTER- children participate or act in group), bodily kinesthetics (BK- the use of body parts, facial expressions and gestures to act) and intrapersonal (INTRA- the internalization of the roles and to express the emotions intelligences concerned). Preschoolers with these four strengths (VL, INTER, BK and INTRA) were expected to benefit from the teaching activity which should then lead to achieving effective learning outcome.

Data of the class observations (See Table 5.2: Observation Summary) on the teaching of CTS infused lessons showed that preschoolers in the various MI groups were quick to engage actively in a wider range of critical thinking activities besides encouraging one another to think further for more suggestions. KidJ and KidK in their focus group interview claimed that they helped each other to find answers (solutions) in the VL group. They said that they discussed with one another and asking each other more questions and suggestions as illustrated in the excerpts below.

> *"… we helped each other to find the answers in our (VL) group…we discussed"* (KidJ, Focus Group interview, 23/11/2017)
>
> *"...we asked each other more questions (suggestions)…"* (KidK, Focus Group Interview, 23/11/2017).

Furthermore, Teacher N commented that assigning specially designed thinking tasks which are related to the various MI proclivities of the children to the respective

MI groups have been very helpful for teaching and developing CTS. She also claimed that the MI based activities allowed selected preschoolers to think better together and they were seen to have completed the tasks faster in their respective MI groups. This implied that selected preschoolers were able to relate better and respond more spontaneously in rather similar ways among members in the same MI groups while working on solving the tasks assigned to them as remarked by Teacher N. The excerpt in the following page depicts Teacher N's remarks.

> *"…I find that MI way of teaching is very helpful for teaching thinking skills. Activities which were planned in accordance to children's MI – they can think better 'together' and they solved problem in rather similar ways."* (Teacher N, interview, 23/11/2017)

Figure 5.6 illustrates the benefits of ISM implementation through MI instructional approach on the critical thinking development of preschoolers in various MI groups.

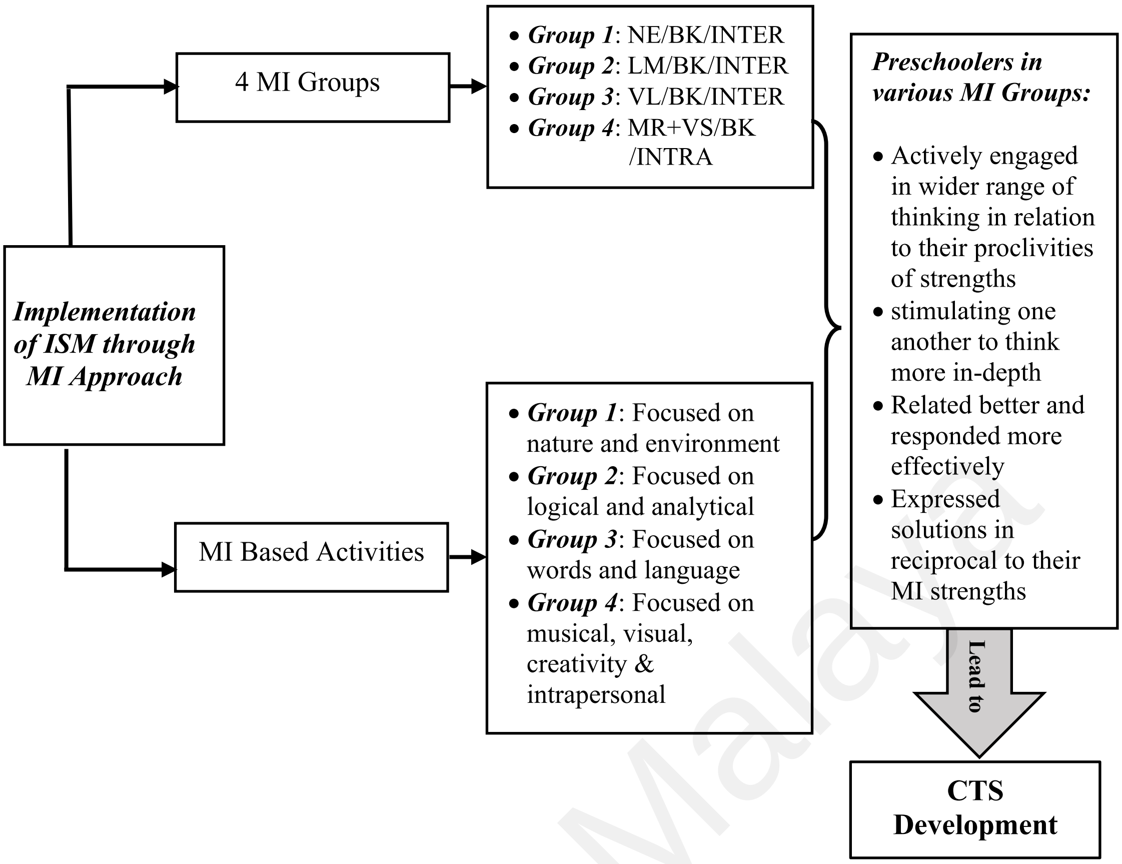


Figure 5.6 ISM implementation through MI Instructional Approach.

Previous studies provided the evidence that the infusion lessons embedded with CTS in the existing curriculum and taught explicitly across a wide range of lesson contents or activities have been favorable approach for older learners (Aizikovitsh & Amit, 2010; Lin 2014; Zobisch et al., 2015). In contrast, this study reflected how explicit teaching of CTS in the form of ISM coupled with MI instructional approach have supported the development of CTS among younger children.

The next session compares and discusses the influence of ISM implementation on the development of CTS among selected preschoolers through analysing and contrasting their CTS levels before and after the ISM implementation.

5.4 Analysis of CTS Levels Before and After ISM Implementation

Based on the discussion on the observation summary, teachers' interviews and the focus group interviews of selected preschoolers, children in the selected preschool classroom were believed to have learnt the skills of thinking critically while going through the infusion lessons of ISM. These lessons were customized to teach critical thinking skills explicitly. This section discusses (as in sections 5.4.1. and 5.4.2 respectively) the comparison of the CTS levels of selected preschoolers to gauge the implication of ISM implementation. The comparison was done by contrasting the CTS levels before and after ISM implementation to complement the data collected through the qualitative method.

5.4.1 Analysing the Levels of CTS Among Preschoolers Before the Implementation of ISM

To answer research question 2 - "What is the level of CTS among selected six-year-old preschoolers at Trinity Kids 'before' the implementation of ISM?", the CTS pre-assessment (Appendix E) was administered to the selected samples to assess their CTS level prior to implementing ISM. Table 5.3 (in the following page) disclosed the scores results of the pre-assessment of CTS (PSCTST_ Pre-Assessment) which were tabulated based on CTS questions and scores allocation (as in section 4.6.1- table 4.8 of chapter 4) and scoring rubrics system (as in section 4.6.3- table 4.9 of chapter 4).

Table 5.3

PSCTST Score Results of Selected Preschoolers (Pre-Assessment)

No	*Name*	*Interpretation*	*Analysis*	*Inference*	*Evaluation*	*Total/Remarks*
1.	KidA	12.5	7.5	5	20	**45 (Weak)**
2.	KidB	12.5	10	10	15	50 (Emerging)
3.	KidC	17.5	17.5	15	15	65 (Emerging)
4.	KidD	17.5	17.5	10	15	65 (Emerging)
5.	KidE	20	12.5	7.5	5	**45 (Weak)**
6.	KidF	20	10	5	15	50 (Emerging)
7.	KidG	17.5	17.5	15	10	60 (Emerging)

Table 5.3 *(continued)*

No	***Name***	***Interpretation***	***Analysis***	***Inference***	***Evaluation***	***Total/Remarks***
8.	KidH	17.5	17.5	15	15	65 (Emerging)
9.	KidI	20	12.5	7.5	15	55 (Emerging)
10.	KidJ	25	22.5	12.5	15	75 (Moderate)
11.	KidK	20	17.5	12.5	15	65 (Emerging)
12.	KidL	20	17.5	12.5	10	60 (Emerging)
13.	KidM	7.5	10	7.5	20	**45 (Weak)**
14.	KidN	22.5	20	12.5	15	70 (Moderate)
15.	KidO	15	15	10	15	55 (Emerging)
16.	KidP	20	12.5	7.5	5	**45 (Weak)**
17.	KidQ	17.5	12.5	15	20	65 (Emerging)
18.	KidR	15	5	5	20	**45 (Weak)**
19.	KidS	15	17.5	12.5	10	55 (Emerging)
20.	KidT	22.5	20	12.5	15	70 (Moderate)

In general, the scores above revealed that:

(1) Five out of the twenty selected preschoolers displayed ***weak critical thinking ability*** which indicated that they failed to understand or relate given information and were unable to draw conclusions for forming any conjectures. They were not able to access the credibility of most claims made by others. This might be due to the fact that the preschoolers (test-takers) concerned did not put in sufficient thinking effort or they could be having problem with reading and comprehension issues.

(2) Six out of twenty of them manifested ‘emerging’ critical thinking abilities whereby the preschoolers involved were able to understand or relate some of the information given or to draw some forms of conclusions and making some reasonable conjectures. They were also able to access the credibility of some of the claims made. This category of preschoolers have the ‘potential’ to be engaged in ‘acceptable’ or ‘quality’ critical thinking abilities.

(3) Three out of the twenty preschoolers were demonstrating 'moderate' critical thinking abilities whereby the preschoolers concerned were able to understand and categorise most of the given information well. They could relate information well to draw accurate predictions and were able to judge the quality of explanations rather well. The preschoolers of this category are said to have displayed a good degree of quality critical thinking abilities and could often make accurate decisions or solving problems more effectively.

In other words, prior to the implementation of ISM, the CTS pre-assessment revealed that majority of the preschoolers (seventeen out of twenty) displayed rather 'weak' or 'emerging' critical thinking abilities which were yet to display the acceptable level of CTS. On the other hand, minority of the preschoolers (three out of the twenty) were demonstrating 'moderate' or 'acceptable' level of critical thinking abilities. None of these selected preschoolers displayed strong critical thinking abilities at this stage.

5.4.2. Analysing the Level of Critical Thinking Among Selected Preschoolers After the Implementation of ISM

After the implementation of ISM, another CTS assessment tool (PSCTST_ post assessment) was administered to the same group of selected preschoolers. The scores of the PSCTST_ post assessment was recorded in table 5.4 (in the following page):

Table 5.4
PSCTST Score Results of Selected Preschoolers (Post-Assessment)

No	*Name*	*Interpretation*	*Analysis*	*Inference*	*Evaluation*	*Total/Remarks*
1.	KidA	10	15	20	15	60 (Emerging)
2.	KidB	15	17.5	17.5	25	75 (Moderate)
3.	KidC	22.5	17.5	20	25	85 (Moderate)

Table 5.4 *(continued)*

No	*Name*	*Interpretation*	*Analysis*	*Inference*	*Evaluation*	*Total/Remarks*
4.	KidD	17.5	20	22.5	25	85 (Moderate)
5.	KidE	20	17.5	7.5	15	60 (Emerging)
6.	KidF	15	17.5	22.5	15	70 (Moderate)
7.	KidG	20	22.5	22.5	20	85 (Moderate)
8.	KidH	20	17.5	22.5	25	85 (Moderate)
9.	KidI	22.5	15	7.5	25	70 (Moderate)
10.	***KidJ***	***25***	***22.5***	***22.5***	***25***	**95 (Strong)**
11.	***KidK***	***22.5***	***20***	***22.5***	***25***	**90 (Strong)**
12.	KidL	20	20	20	25	85 (Moderate)
13.	KidM	17.5	12.5	15	15	60 (Emerging)
14.	***KidN***	***22.5***	***22.5***	***20***	***25***	**90 (Strong)**
15.	KidO	20	15	20	15	70 (Moderate)
16.	KidP	12.5	15	17.5	15	60 (Emerging)
17.	KidQ	15	20	25	20	80 (Moderate)
18.	KidR	12.5	15	17.5	15	60 (Emerging)
19.	KidS	17.5	20	22.5	15	75 (Moderate)
20.	***KidT***	***22.5***	***20***	***22.5***	***25***	**90 (Strong)**

The score results in table 5.3 indicated that:

(1) *None* of the preschoolers scored under the category of weak level in critical thinking for the post-assessment. This implied that the five (out of twenty) preschoolers who displayed 'weak' critical thinking abilities recorded earlier in the pre-assessment have progressed and showed improvement in their critical thinking abilities. Many of these pre-schoolers were seen to have engaged in applying the core cognitive skills such as interpretation, analysis, inference and evaluation through completing the thinking tasks during the implementation of ISM.

(2) The post-assessment of PSCTST score-results revealed that more than half of the selected pre-schoolers (eleven out of twenty) were demonstrating the abilities to think as 'moderate' thinkers after the ISM implementation as compared to three (out of twenty) before the ISM implementation. In other words, these selected preschoolers were able

to perform a higher level of 'quality critical thinking' in terms of more effective decision making instead of the 'acceptable level' after going through the CTS infused lessons of ISM.

(3) Data from the post-assessment also revealed a significant outcome or improvement after the ISM implementation in which four out of twenty selected preschoolers have reached the level of 'strong critical thinking'. This strongly indicated that the four children possessed the ability to perform 'advanced critical thinking'. The group of 'strong thinkers' were expected to make decisions and solving problem more confidently and accurately.

On the whole, the scores result of PSCTST _ post-assessment revealed a significant improvement in the CTS levels of all the selected preschoolers of this study. It implied that all the selected preschoolers have achieved and displayed signification improvement in their CTS levels after going through the infusion lessons (ISM Set) for eight weeks. This further implied that the explicit teaching of CTS through ISM implementation or infusion lessons with MI approach as the instructional strategy had achieved its objectives in helping selected preschoolers developed CTS more effectively.

5.4.3 Comparison of CTS Levels and Implication of ISM Implementation

For the purpose of gauging the implication of ISM implementation and the teaching of CTS through MI based thinking tasks, a comparison of the scores for both the PSCTST assessment tools (Pre-Assessment and Post-Assessment) was perpetrated.

The comparison of the score results was illustrated in table 5.5 in the following page).

Table 5.5
Comparison of PSCTST Score Results (Pre- and Post-Assessment) of Selected Preschoolers

No	***Name***	***Pre-Assessment***	***Post Assessment***	***Remarks***
1.	KidA	45 -weak	60 - emerging	Improved – 15 points
2.	KidE	45 – weak	60 - emerging	Improved – 15 points
3.	KidF	50- emerging	70 – moderate	Improved – 20 points
4.	KidM	45 - weak	60 – moderate	Improved – 15 points
5.	KidP	45 - weak	60 - emerging	Improved – 15 points
6.	KidS	55- emerging	75 – moderate	Improved – 20 points
7.	KidB	50-emerging	75 – moderate	Improved – 25 points
8.	KidC	65 – emerging	85 – moderate	Improved – 20 points
9.	KidD	60 - emerging	85 – moderate	Improved – 25 points
10.	KidJ	75 - moderate	95 – strong	Improved – 20 points
11.	KidK	65 - emerging	90 – strong	Improved – 25 points
12.	KidG	60 - emerging	80 – moderate	Improved – 25 points
13.	KidH	65 – emerging	85 – moderate	Improved – 20 points
14.	KidL	60 – emerging	85- moderate	Improved – 25 points
15.	KidN	70 - moderate	90 – strong	Improved – 20 points
16.	KidI	55- emerging	70 – moderate	Improved – 15 points
17.	KidQ	65 – emerging	80 - moderate	Improved – 15 points
18.	KidR	45 – weak	60- emerging	Improved – 15 points
19.	KidO	55 - emerging	70 – moderate	Improved – 15 points
20.	KidT	70 - moderate	90 - strong	Improved – 20 points

Table 5.5 showed that all the selected preschoolers in the various MI groups recorded an encouraging improvement in their critical thinking skills between the scores of fifteen to twenty-five (15-25) points with half of the preschoolers recorded at least a twenty (20) points of increase. This implied that the specifically designed interventional ISM with CTS infused lessons MI based thinking activities had a significant contribution on the development of CTS among the selected preschoolers. The comparison of the two CTS assessments further revealed that all the five selected preschoolers who were categorised as ‘weak’ thinkers in the pre-assessment have progressed as ‘emergent’ or ‘moderate’ thinkers. They began to display greater potential in the ‘acceptable level of critical thinking’ after the ISM implementation.

The graph below (Figure 5.7) shows the contrast on the score results of both the PSCTST tools for assessing the CTS levels of the preschoolers before (pre-assessment) and after (post-assessment) the ISM implementation. The data analysis from the graph indicated that there is a distinct improvement in the CTS levels of selected preschoolers after the ISM implementation.

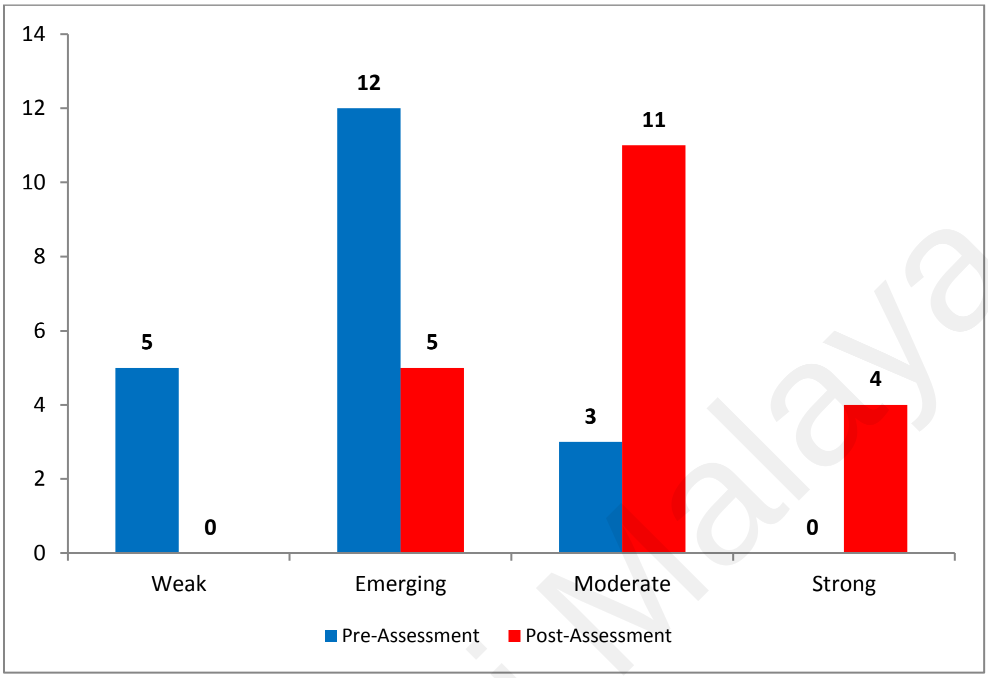


Figure 5.7 The Graph on the comparison of the score results of PSCTS Tools (Pre-Assessment and Post-assessment)

In general, the scores result of PSCTST (Post-Assessment), showed a notable improvement in the level of CTS across the whole class of selected preschoolers after eight weeks of implementing ISM. This result seemed to imply that the implementation of ISM has brought significant benefits to the preschoolers through the CTS infused lessons and MI based thinking tasks.

Prior to the implementation of ISM, seventeen (out of the twenty) selected preschoolers were found displaying low levels in CTS - inclined towards weak and emerging levels. However, with the intervention of ISM, a significant degree of improvement was noticed whereby fifteen (out of the twenty) preschoolers were noted to have displayed encouraging progress to higher levels in CTS – the levels of moderate and strong. This strongly implied that having gone through the eight weeks' intervention of infusion lessons, selected preschoolers were able to exhibit better ability in critical thinking and the ISM has achieved its objective in teaching CTS explicitly to the selected preschoolers.

The implication of the comparison summary suggested that the intervention of CTS infused lessons through the implementation of ISM has a significant impact in the development of CTS among the preschoolers. The findings indicated that the preschoolers benefitted from the effective ISM implementation, through the infusion approach for CTS to be taught explicitly, the preschoolers' thinking skills were fostered. It also further implied that with explicit teaching of CTS made mandatory in the preschool curriculum/classroom for teachers, it would contribute to the better development of CTS among the preschoolers.

Finding from the data of ISM implementation also further concurred with the studies conducted by McGuiness (2005), Taggart et al. (2005). Lai (2011), Aubrey et al. (2012) and Birbili (2013) that infusion approach is a more promising approach for teaching CTS explicitly to young children. The next section presents the summary of this chapter.

5.5 Chapter Summary

This chapter has discussed firstly how the framework for ISM was drawn up based on the numerous discussions and brainstorming sessions with the ECCE experts from Trinity Kids. Then, based on the framework, the features of ISM were designed. The ISM framework served as the backbone for designing the contents of the infusion lessons through which CTS was taught explicitly to the selected preschoolers.

Two PSCTST tools were employed to gauge the contribution of ISM implementation on the CTS development of selected preschoolers. The analysis of the scores of both the PSCTST tools (pre-assessment and post-assessment) indicated a significant improvement in the development of CTS after the ISM implementation. This suggested that the selected preschoolers have developed better abilities in interpreting information provided, analysing the available information, making inferences or proposals and evaluating the decisions or solutions made for solving the thinking task as per the purpose of this study.

If children are to become better critical thinkers, to think more in-depth and to make reasoned decisions; they need to be taught explicitly how to do it. Teaching of CTS through the implementation of ISM and supported by MI based thinking activities showed a clear evidence of improvement in the critical thinking abilities among the selected preschoolers as indicated by the score results of the two PSCTST tools. Majority of the selected preschoolers showed that they were able to apply the four cognitive skills of critical thinking to solve most of the questions in the post assessment of PSCTST after the ISM implementation. This further indicated that selected preschoolers have benefitted from the CTS infused lessons in their CTS development. This finding is comparable to the claims made by Swartz and McGuiness (see chapter 2, section 2.5.1) which stated that infusion approach is expected to be effective for teaching CTS.

In the next chapter, the researcher will present the findings through analysing the data collected from observations and interviews to describe the development of CTS among the preschoolers to address the rest of the research question.

CHAPTER 6

THE DEVELOPEMNT OF CRITICAL THINKING SKILLS IN THE PRESCHOOL CLASSROOM

6.1 Introduction

This chapter is dedicated to discussing the findings for answering the third and fourth research questions: “How is the development of CTS among the selected six-year-old preschoolers of Trinity Kids?” and “How is the CTS acquired among the selected six-year-old preschoolers of Trinity Kids applied for problem solving?”

Preschoolers apply critical thinking skills in their everyday living although their knowledge and experience may be limited. The whole process of critical thinking which engages the mental or cognitive skills to interpret and analyse information around them, draw applicable inferences, evaluate the credibility of claims, assess and explain the reasons of choices made and to self-correct is essential for making decisions daily and solving everyday problems (Educate Insight, 2018).

The next section then discusses the possible process of CTS development among the selected preschoolers through the ISM implementation of this present study.

6.2 The Development of Critical Thinking Skills in This Study

This section discusses the development of CTS among the selected six-year-old preschoolers. The analysis of the various forms of research data revealed several factors which point to the possible development process of CTS in the selected preschool classroom. The development process of CTS among the selected preschoolers (six years old) in the Trinity Kids classroom is described based on six factors derived from the key themes condensed from the early codes (as discussed in Chapter 4, section 4.9.3).

In this context, six factors were found to be related to the development of CTS among the selected preschoolers in this study are: (1) readiness towards learning to think critically, (2) in-depth thinking through explicit teaching and learning of CTS, (3) social constructivism by scaffolding for critical thinking, (4) cognitive constructivism by critical thinking routines,(5) responding to a ‘thinking challenges’ classroom climate and (6) interplay of MI strengths in critical thinking.

6.2.1 Readiness Towards Learning to Think Critically

One of the common observations from almost all the infusion lessons during ISM implementation was that the preschoolers in the selected preschool classroom were often seen to have displayed readiness in learning to think and eagerness to participate in all the thinking activities from the infusion lessons. Both KidT and KidK expressed their delights that they could learn to think through the thinking activities of the ISM as shown in the excerpts below:

> *“I like the activities. I can learn to think.” (*KidT, Focus Group Interview, 22/11/2017*)*
>
> *“… Because the activities were fun. I can learn to think.”* (KidK, Focus Group Interview, 23/11/2017)

The selected preschoolers were found to be enthusiastic in completing the thinking activities either individually or collectively as a group as commented by Teacher M:

> *“The children enjoyed the thinking activities. At the beginning of the first lesson, they didn’t seem to be thinking much… After the second lesson…they began to think more...They started to think more in-depth on their own and even when in group…”* (Teacher M, Interview, 23/11/2017)

The focus group interview of selected preschoolers concurred that the selected preschoolers willingly or readily took on the challenges of the thinking activities and expressed that they enjoyed learning to think more in-depth (critically). Both KidA and KidN claimed that they enjoyed the thinking activities and the opportunity of learning to think. They both felt good that they were able to think.

> *"I can do the activities and I feel that I am good because I have learnt to 'think' and I know how to think." (*KidA, Focus Group Interview, 23/11/2017*)*

> *"I like the activities. I like to think for myself to find the answers."* (KidN, Focus Group Interview, 23/11/2017*)*

From the observation, selected preschoolers were often seen readily 'discussing together'. These preschoolers frequently 'asked the facilitator questions' in order to understand (interpret) the instructions and information provided. Selected preschoolers were keen to 'reason' with each other for the possible answers or suggestions of ideas (Refer to Chapter 4, Table 4:15- Observation Protocol- Day 1: Part B- 1). This further implied that the preschoolers possessed readiness towards the learning of thinking more critically.

Enthusiastic in completing thinking activities
Enjoyed learning to think critically
Readily discussed together
Frequently asking questions
Keenly reason with each other for ideas
Felt good when they were able to think

Positive attitudes towards learning to think more critically (in-depth)

Figure 6.1 The readiness of selected preschoolers towards learning to think critically

Overall, through the feedback from observations and interviews, selected preschoolers were seen to display eagerness in learning and executing the thinking tasks, thus reflecting a sign of readiness to be involved in thinking. This implied that young children have the potential to think critically and are ready for critical thinking whenever opportunities are given. This implication concurred with the findings of Jean Davis-Seaver (2000) and Silvia (2008) who found that the readiness towards learning to think was a primary motivation towards fostering the development of CTS among these selected preschoolers.

6.2.2 Explicit Teaching and Learning of In-depth Thinking

Acceding to the infusion approach suggested by Swartz and Parks (1994) for explicit teaching of CTS and for the purpose of this study, infusion lessons were specifically designed to incorporate the four core cognitive skills of critical thinking into the existing syllabus. The data gathered from classroom observations on the delivery of all the infusion lessons (through ISM implementation) and the interviews with the selected teachers revealed that selected preschoolers had benefitted from the infusion lessons in that they began to display more in-depth thinking or think more purposefully involving the core cognitive skills (such as interpretation, analysis, inference and evaluation) while completing the thinking tasks in the classroom.

The researcher found that the thinking activities of the infusion lessons encouraged the preschoolers to think more in-depth to look for answers or solutions as they worked on the tasks assigned in comparison to the traditional existing lessons. For example, during the fourth lesson of mathematics, selected preschoolers were given the task to form the a few combinations for the amount of ‘Twelve Ringgit’ (RM12.00) with the ‘toy money’ provided by teacher as discussed in Chapter 4, section 4.7.1. It was observed that they took time to explore and think further on all the possibilities instead of just giving one prompt solution as in earlier lessons. For example, they thought of various possible combinations such as: (1 x RM 10 + 2 x RM1), (2 x RM 10 + 2 x RM 1), (1 x RM 5 + 7 x RM 1), (12 x RM 1) and so on. This gesture of exploring and thinking further for more inferences were indications of critical thinking process.

Furthermore, the subject teacher (Teacher M) commented that the preschoolers were observed to practice better critical thinking after the second lesson. They began to 'think more deeply (in-depth)' on their own.

> *"The children enjoyed the thinking activities. At the beginning of the first lesson, the children were not really able to 'think' well. They needed their teachers to help them. But, after the second lesson, I could see them began to think more without getting much help from the teachers. At the fourth and fifth lesson, they really started to 'think' more deeply on their own."* (Teacher M, Interview, 23/11/2017)

In the focus group interview, some of the preschoolers claimed that they appreciated the CTS infused lessons which have led them to think more in-depth. They believed that their thinking abilities had increased through their involvement in the thinking activities. For example, KidJ perceived that he has become smarter now that he has learnt to think 'more' while KidA was proud that she could think better to complete the tasks and to find solutions. KidB also felt that the thinking tasks were less difficult for him to execute after going through the infusion lessons. These feedbacks were captured in the excerpts below:

> *"I liked the activities because they made me think more (in-depth). I like thinking because I became smart"* (KidJ, Focus Group Interview, 22/11/2017)
>
> *"If we know how to do the work (complete the thinking activities), means that we are good (smart) children, we can think better.*" (KidA, Focus Group Interview, 23/11/2017)
> *"…(they) the activities were easy now, I can (do it) solve them…"* (KidB, Focus-Group Interview, 23/11/2017)

The above implied that the preschoolers became more confident in solving thinking tasks after going through the infusion lessons for eight weeks as they progressively involved in more in-depth thinking.

In addition to the feedback from focus group interviews, Teacher G also appreciated infusion lessons (ISM) as the vehicle which had provided the opportunities for the preschoolers to learn and use critical thinking skills (McGuiness, 2014) through all the thinking activities which were not provided in the normal syllabus under the national preschool curriculum. The teachers believed that the selected preschoolers had benefitted much from the infusion lessons in terms of developing stronger ability in thinking more in-depth or critically as commented by Teacher G:

> *"These children's thinking ability is limited, they need to be given the opportunities to learn critical thinking… like these (infusion) lessons … instead of the conventional ways of learning (lessons)…At least now they have learnt to think deeper (critically*)…" (Teacher G, Interview, 23/11/2017)

Furthermore, both the PSCTST score results also indicated a significant improvement in the levels of critical thinking abilities of the preschoolers after the implementation of the infusion lessons. This strongly implied that the infusion lessons contributed significantly to the development of CTS among the preschoolers. This implication is in accord with the claim made by Aubrey et al. (2012), Birbili (2013) and Taggart et al. (2015) in their studies that explicit teaching thinking skills lead to the development of CTS among young children. The display of much stronger critical thinking abilities among the selected preschoolers after ISM implementation was a strong evident that they have benefited from the infusion lesson in their CTS development (illustrated in figure 6.2).

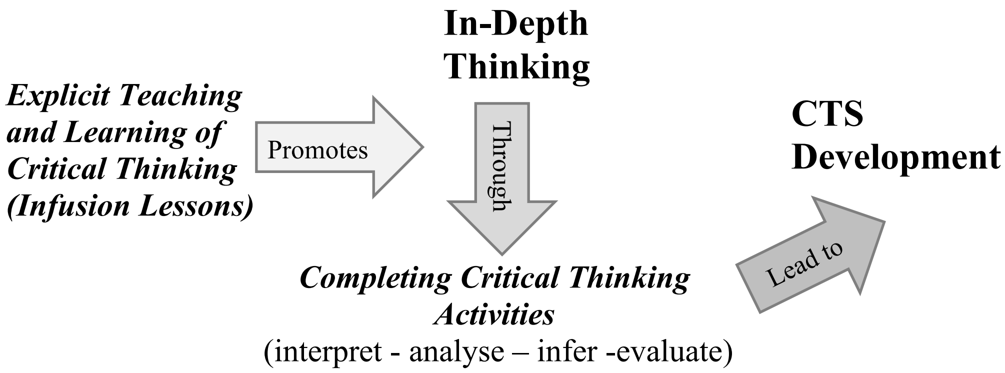


Figure 6.2 Promoting In-depth thinking for strengthening CTS development through Infusion Lessons

6.2.3 Social Constructivism through Scaffolding for Critical Thinking

Throughout the observations on group activities (Chapter 4, Table 4.15- classroom observations: video: Mathematics Lesson 1 and English Lesson 1), selected preschoolers were seen to have actively engaged in the discussions freely with peers of the respective groups while completing the thinking tasks. It was also observed that the preschoolers in the respective groups provoked each other for deeper thinking by 'asking' for more ideas. For example, during the group discussions they frequently asked question such as "Can we think of how to 'do' (complete) this? "These observations were further confirmed by the feedback from selected preschoolers during the focus group interviews. The few preschoolers articulated that they liked the fact that through asking their peers more questions, they helped one another think of more answers or solutions. KidJ and KidB expressed that they could explain their ideas and 'argue' about their thoughts to their peers during the group discussions. Both KidJ and KidB also felt that as a group, they could help each other to better recall clues or information which enabled them to find the answer or solve a problem. This implied that with the support from peers, the preschoolers could now foster stronger 'thinking' skills for 'churning' out more suggestions. Below is the excerpt of KidJ's and KidB's comments.

> "*We helped one another to find answers…. like a team helping the group…... We asked each other more questions to get more ideas (and argued) until everyone knows (understands)…*" (KidJ and KidB, Focus Group Interview, 22/11/2017).

Teacher M (as per the excerpt in the following page) also pointed out that when the children in her group discussed together, they reasoned and argued with their peers on their thoughts or ideas. The preschoolers were also observed to have been rechecking and rethinking of their 'answers' with their peers until they agreed on the selected answers. This seems to indicate that the selected preschoolers were provoked to further thinking by their peers in the group.

> *"I observed that children when discussed in groups on the answers they think, they 'reasoned' and 'argued' with their friends… some of them would rethink and check their answers until they got the solutions…"* (Teacher M, Interview, 23/11/2017)

As Vygotsky (cited in Robson, 2012) claimed that the mental activities begin and thoughts expand when children started to have verbal exchanges with their peers such as arguing or asking one another more questions. In this perspective, the selected preschoolers were stimulated and motivated to think further or deeper (critically) by their peers through their discussions in the process of solving thinking tasks in the MI groups. When the preschoolers argued or made efforts to explain their thoughts and ideas as a group; their critical thinking abilities were strengthened and provoked. This indicated that the potential for critical thinking of the preschoolers was being scaffolded by their peers.

On the other hand, research findings show that adults' support especially teachers' support in provoking and promoting children's thinking in the classroom through effective questioning techniques has a long-term gain (Dowling, 2013) in helping children improve their thinking skills. The teachers of this study were observed to have constantly used 'open questions' such as "What else can we do?", "Why did this happen?" or "How else can we solve this task?". These 'open questions' were found to offer wider range of challenges which demanded more cognitive reasoning from the preschoolers. Thus, open questions allowed the teachers to provoke deeper thinking among the preschoolers. For example, when the teacher asked the children to 'think' of "what else can we do?" instead of "what did you do?", children were challenged to explore deeper or more purposeful thinking to generate more suggestions and inferences for solving a problem rather than just providing one solution.(Refer to Chapter 4, Table 4.15- Classroom Observation Protocol: Lesson 4-5: Part F- 2)

Teacher N (refer to excerpt below) also remarked that children need the teachers to guide them in thinking by asking more 'prompting' or 'probing' questions such as, "What do you understand about the problem or issue?', "What can you gather from the information provided?" and "What suggestions do you have?"

> "*The children required the teachers to guide them and maybe like provide some steps on how to think (critically), some prompting or probing questions or some ways on how to think deeper…"* (Teacher N, Interview, 23/11/2017)

Findings from recent studies advocate for teachers to serve as facilitators in group discussions, encouraging peer reviews of each other's opinions and helps children learn appropriate responses to conflicting opinions in order to engage children in thinking more critically (Watanabe-Crockett, 2015). A teacher should be able to scaffold the critical thinking of the preschoolers' Zonal Proximal Development (ZPD) by providing additional directions (Smolucha & Smolucha, 1989, 2015). The use of questioning techniques and the modelling of enquiry by these teachers were valuable directions for young children to acquire more critical thinking as they learnt to reason and infer possible options for answering the questions (Fisher, 2005; Robson, 2012).

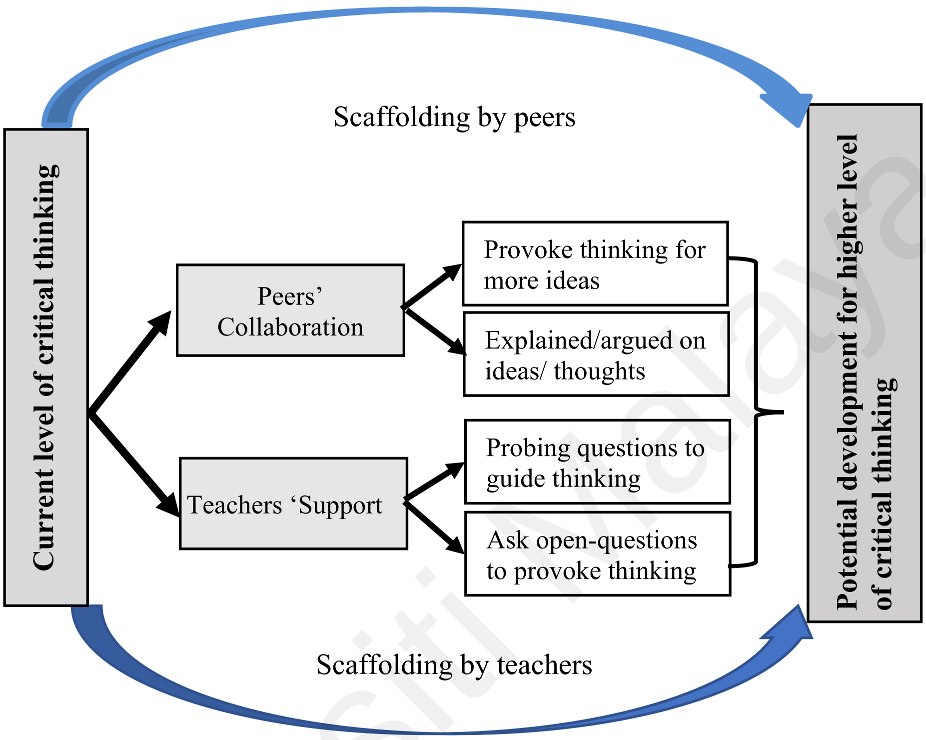


Figure 6.3 Impact of Scaffolding from teachers and peers on CTS development

In the context of this study, the support from teachers and collaborations with peers scaffolded the ZPD of the selected preschoolers to reach their potential for higher level of critical thinking abilities from their current level of abilities (as illustrated in Figure 6.5). Preschoolers learnt to think more critically when they discussed and explained or argued with one another about their thoughts and ideas. In addition, preschoolers were provoked to think more critically as they were challenged to respond to probing questions purposefully posed by their teachers.

6.2.4 Cognitive Constructivism through Critical Thinking Routines

Thinking or critical thinking in particular, is a cognitive skill that does not happen by itself; it has to be intentionally taught or developed (Robson, 2012; Kibui, 2012). Young children do require to learn the technique of thinking critically in order for them to know 'how' to apply the skills in their everyday life.

In the present study, it was observed (as discussed in Chapter 4, Table 4.15-Observation Protocol: Lesson 4-5: Part F-2) that during the lessons delivery and group discussions teachers were intentionally and consistently posing a specific set or patterns of questions. This technique of questioning was part of the teaching lesson content for the infusion lessons to stimulate "critical thinking" such as:

1. Do you understand the information given?" or "What does the question mean?" (*Interpretation*).
2. What can you gather/what have you observed from the information given?" or "Why did you think so?" (*Analysis*)
3. "What can you suggest or do?" or "What ideas do you have?" (*Inference*)
4. Do you think that your suggestions/answers are good/correct?" or "Are there other ways?" (*Evaluation*)

These four questions were directly associated with the four cognitive skills of interpretation, analysis, inference and evaluation respectively. The constant posing of this form of structured questions related to the four core cognitive skills by the teachers, led to a form of 'thinking routine' for the preschoolers.

This form of structured questioning technique seems to fall in line with the thinking routines suggested by Project Zero (Salmon, 2010) which claims that children learnt to think through a specific manner (in this case, critical thinking) when they were shaped by a 'ritualised' form of thinking culture consistently over a period of time. In short, the preschoolers would have developed a consistent manner of critical thinking as they attempted to answer the set of structured questions. In this context, the preschoolers were exposed to a thinking routine throughout the implementation of ISM or infusion lessons over a period of eight weeks.

Teacher M commented that guidance provided by teachers through asking questions in a structured 'question pattern' or thinking routine, helped to provide the pathway for children to think more 'critically' as stated below.

> *"The children are able to think…but need guidance from the teachers to help them think critically…I found that having a fixed pattern of asking questions was very helpful… children practised CTS using the pattern…"* (Teacher M, Interview, 23/11/2017)

In addition, Teacher N also concurred that children couldn't think critically on their own without being guided or taught to do so through a structured thinking pattern or a thinking routine (refer to excerpt below).

> *"Initially, the children in my class were not able to think critically…but with us, the teachers asking questions in a kind of pattern, spurred them to think more critically now…"* (Teacher N, Interview, 23/11/2017)

In this study, the young preschoolers were observed to be well-guided by the thinking routines which have directed them towards the process of critical thinking. This observation concurred with the finding of the studies conducted by Salmon and Lucas (2011) which claimed that young children benefitted from the implementation of thinking routines in their classroom. In an earlier study, Salmon (2008) also claimed that the use of routines engaged children in thinking activities whereby they become more alert to response to situations which stimulate their critical thinking.

This strongly implied that such form of structured questioning technique would help to establish a thinking routine which exposed preschoolers to a more purposeful and in-depth way of thinking. The selected preschoolers in the present study were provided with a sequence of specific pattern of questions in the form of thinking routines which aimed towards the development of the four cognitive abilities of critical thinking. In this context, teachers were using the thinking routine to challenge deeper thinking among selected preschoolers. In other words, the thinking routines have possibly helped to shape a ritualised and consistent manner of thinking was believed to help the selected preschoolers develop their CTS (as in Figure 6.5).

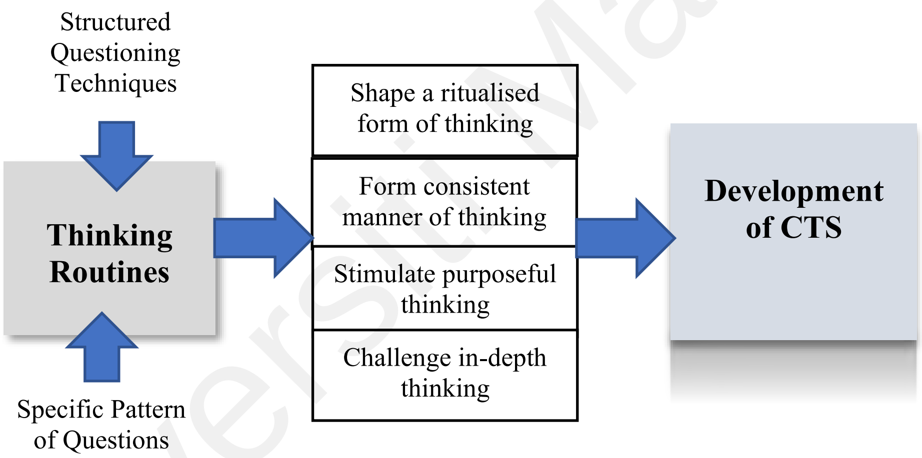


Figure 6.4 Thinking routines contributed to the development of CTS

6.2.5 Responding to a Classroom Climate which Challenges Thinking

Studies revealed that children's critical thinking skills can be fostered if teachers create a challenging thinking environment in the classroom to support their critical thinking (Muhammad Ahmad Assaf, 2009; Firdaus et al., 2015; Taggart et al., 2005).

In this context, the thinking activities of ISM provided the opportunities and environment which challenged the selected preschoolers to reason and think more in-depth. Through these activities, the selected preschoolers were required to interpret the problems, analyse the given information, reason with one another on the possibilities or inferences as well as to deliberate and evaluate the choices of solutions.

In other words, the purposeful-designed group thinking activities of ISM created a challenging intellectual climate for the preschoolers to be involved explicitly in practising critical thinking. Preschoolers were encouraged to go beyond simple thinking, to think more purposefully and reflectively in challenging their cognitive capacities.

As reported by Teacher M who facilitated the group activities that from the third lesson onwards, children were seen to have 'argued' and 'reasoned' on their points of views instead of just accepting others' opinions.

> *"From the third lessons onwards, I observed that children when **discussed in groups** on the answers they exercised 'thinking' more, they '**reasoned**' and '**argued**' more on their points of views and ideas."* (Teacher M, Interview, 23/11/2017).

Another observation made by Teacher N was that children in the various groups did deliberate and listen to one another's suggestions before deciding to agree or disagree during their discussions.

> *"During the group thinking activities discussions, children did listen to their friends' ideas when they discussed together for the answers they want to agree upon."* (Teacher N, Interview, 23/11/2017).

In this same context, from the observation data (Appendix M: Part D_ 5, page 399), with an environment designed to challenge thinking through the thinking activities and group thinking tasks; selected preschoolers were observed to have actively engaged in arguing or reasoning to defend their own opinions but at the same time were willing to consider others' suggestions. Arguing, reasoning and deliberations on different opinions before making the final choice are strong features of critical thinking skills. This is a strong indication that they were practicing critical thinking. This further suggests that classroom climate which challenges children's thinking capacities or structures was established during the execution of group thinking activities as selected preschoolers expressed, argued and reasoned on their thoughts and opinions.

The subject teacher (Teacher M) further expressed that young children need to be provided with the opportunities or the platform to stimulate their critical thinking abilities in the classroom such as the thinking activities. Thus, indicating that a challenging thinking climate created by the teachers in the classroom for the preschoolers to be engaged in more in-depth thinking would strongly promote the development of CTS among the preschoolers as shown in Figure 6.6.

> *"They need to learn to* ***analyse and support*** *their own answers or solutions and not just follow their friends' answers…. We need to give them the* ***opportunities*** *to think more critically like the thinking tasks."* (Teacher M, Interview, 23/11/2017)

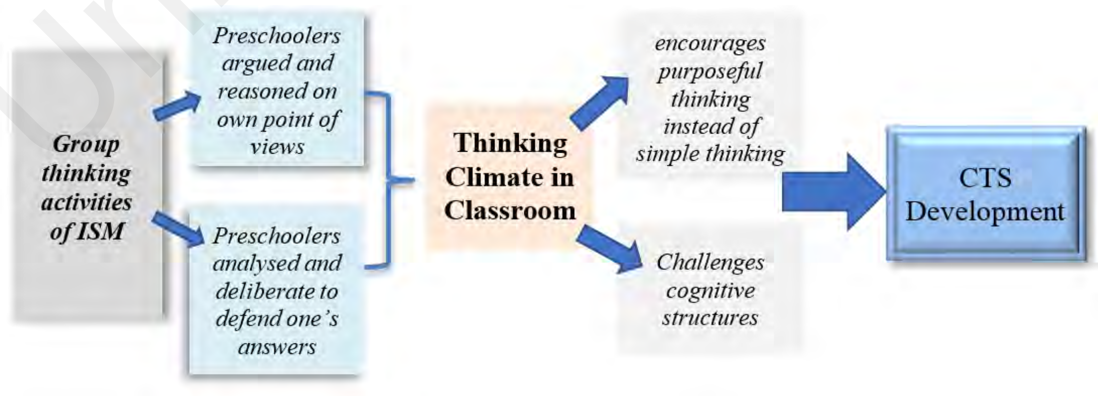


Figure 6.5 Thinking climate for preschoolers promoted CTS development

6.2.6 Interplay of MI Strengths for Critical Thinking

One of the key features of MI based activities in this study was the collaborative learning (Xie & Lin, 2009; Lunenburg & Lunenburg, 2014; Zobisch et al., 2015) which allowed peers of the same strengths to work together besides addressing the various learning propensities of individual learner. The support of MI based activities for teaching the CTS in this study was believed to have stimulated immense learning interest among the selected preschoolers of similar strengths in various MI groups. In this context, the preschoolers were observed to have worked very well together in their respective MI groups (Refer to Chapter 5, Table 5.2: Observation Summary).

It was also observed that the preschoolers appeared to have activated their thinking abilities more effectively and efficiently together in the same MI group. They seemed to think in 'similar' proclivity which could lead to more productive and efficient accomplishment of tasks. For example, Mathematics: Lesson 2: "comparison of 'bigger' or 'smaller' numbers (See Chapter 4, Table 4.15- video: MAH 00098); the preschoolers in the VL group tended to interpret the numbers value in words or sentences better, the NE group were using the pictorial illustration of the 'crocodile mouths' to indicate the comparison of bigger or smaller number value while the VS+MR group were using the symbols such as '>' to represent the 'bigger' value between the two numbers compared.

Teacher F (facilitator of NE Group) commented on the following observation which concurred with the observation made by the researcher of this study.

> *"I think it helped to look at the MI strengths…The children in my group (NE group) may not express well with language but they expressed better with materials related to nature such as animals, plants and environment…I see that Group 4 (VS +MR) did better with symbols and illustrations…." (Teacher F, Interview, 23/11/2017)*

Furthermore, Teacher M accorded that MI activities for the various MI groups were more benefitting to the children in terms of accelerating the process of learning and skills development (CTS development, in this case). Teacher M further claimed that children who shared the same MI strengths in the MI groups can collaborate more efficiently together in completing the MI based thinking activities that correspond to their MI strengths as compared to a mixed MI group. (Refer to the interview excerpt below.)

> "*Yes, I observed that activities which are MI based are more benefitting for children in the MI groups. Children with the same MI strengths can 'collaborate' better together and they can complete tasks faster in their groups. For example, my group - LM (logical-mathematical) group, they worked best and faster with activities related to mathematics and logic….*" (Teacher M, Interview, 23/11/2017)

Teacher N also observed that preschoolers with the same MI strengths in the same MI group seemed to be able to solve thinking tasks faster. Both the teachers further commented that selected preschoolers have gained better critical thinking abilities through solving thinking tasks collaboratively in their MI groups. Below is the excerpt of Teacher N's interview:

> *"I appreciate the MI based activities for the various MI groups and I try to have them in all my lessons (besides the infusion lessons) so that the children who have the same MI can have more (stimulations) for better learning (and skill development) together."* (Teacher N, Interview, 23/11/2017)

At the same time, the observation (Chapter 4, Table 4:15- classroom observation: video: Science lesson 2: MAH 000127) revealed that selected preschoolers spurred each other to improve their 'thinking' abilities while engaging in completing the thinking activities which were inclined to their proclivities of specific MI strengths. The researcher also noticed that children in the same MI group seemed to collaborate better in the ways they appreciate, organise or analyse information of the thinking activities or tasks. Teacher M further shared that the selected preschoolers in her LM Group encouraged each other to think in the logical and analytical manner rather naturally.

> *"Also, children in my (LM) group encouraged each other to think in the logical ways rather naturally…"* (Teacher M, Interview, 23/11/2017)

This seems to further indicate that learners of similar MI strengths tend to learn and think best together as the collaboration allowed the interplay of various MI strengths which is believed to have contributed and lead to a more effective development of CTS (as illustrated in Figure 6.6). The general claims of previous studies referred collaboration of learning more to the display of interpersonal and intrapersonal intelligences, (Xie & Lin, 2009; Lunenburg & Lunenburg, 2014; Zobisch et al., 2015). In contrast to that, this finding referred to the advantage of collaborating or working together of the same strength or intelligence in the group where selected preschoolers in the same MI group were seen helping/scaffolding each other in their CTS development. This means that the interplay of MI strengths has a positive effect on children's CTS development which concurs with the findings of previous studies conducted by Xie & Lin (2009) and Alhamuddin & Bukhori (2016).

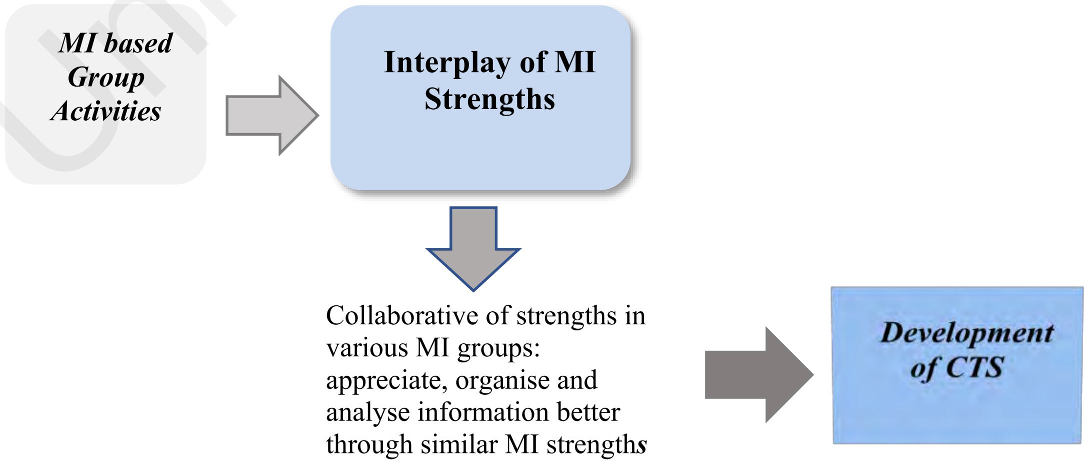


Figure 6.6 Interplay of various MI strengths in the various MI Groups contributed to the development of CTS.

6.3 Development of CTS in the Various MI Groups

In relation to the focus of this study in exploring the development of CTS among the young six-year-old pre-schoolers with MI approach as the vehicle, thus the interplay of MI strengths in each group would now be discussed in this section.

Section 5.3.1 (of Chapter 5) provided the explanation on how CTS infused lessons were delivered through MI based activities such as activities for Group 1 (NE) focused on nature and environment; activities for Group 2 (LM) focused on logical and analytical; activities for Group 3 (VL) focused on words and languages while activities for Group 4 (VS & MR) are related to musical, visual and creativity. The aim of adopting MI as an instructional approach was to allow children to learn more successfully through activities which are aligned with their proclivities of intelligences (Armstrong, 2009).

In this study, each of the MI groups was assigned thinking activities or tasks specifically designed for the respective groups as discussed in section 5.3.1 (See Table 5.2_Observation Summary). Selected preschoolers were observed to have better appreciated the information in relation to their areas of strengths, for example, the verbal-linguistic group appreciated the information provided in narrative and story forms while the visual-spatial group understood illustrations and graphic data better. This indicated that children in respective MI groups responded better to thinking activities which are related their areas of strengths as discussed in section 6.2.6 above.

The score results of the PSCTST- post assessment indicated that there was an encouraging improvement in their level of critical thinking skills after the implementation of the ISM which was delivered through the MI instructional strategy. A comparison of the score results from both the pre-assessment and pot-assessment of

PSCTST (refer to table 6.1) provided the descriptions of the CTS development for the various MI groups. The next section describes the development process in the groups.

Table 6.1
Comparison of PSCTST Score Results in Various MI Groups

No	***Name***	***MI Groups***	***Pre-Assessment***	***Post Assessment***	***Remarks***
(Group 1 - NE Group)					
1.	KidA	*NE*	45 -weak	60 - emerging	Improved (15)
2.	KidE	*NE*	45 – weak	60 - emerging	Improved (15)
3.	KidF	*NE*	50- emerging	70 – moderate	Improved (20)
4.	KidM	*NE*	45 – weak	60 – emerging	Improved (15)
5.	KidP	*NE*	45 - weak	60 - emerging	improved (15)
6.	KidS	*NE*	55 - emerging	75 – moderate	improved (20)
(Group 2 – LM Group)					
7.	KidB	VL	50 - emerging	75 – moderate	Improved (25)
8.	KidC	VL	65 – emerging	85 – moderate	Improved (20)
9.	KidD	VL	60- emerging	85 – moderate	Improved (25)
10.	KidJ	VL	75 - moderate	95 – strong	Improved (20)
11.	KidK	VL	65 – emerging	90 – strong	Improved (25)
(Group 3 – VL Group)					
12.	KidG	LM	60 - emerging	85 – moderate	Improved (25)
13.	KidH	LM	65 - emerging	85 – moderate	Improved (20)
14.	KidL	LM	60 – emerging	85- moderate	Improved (25)
15.	KidN	LM	70 - moderate	90 – strong	Improved (20)
(Group 4 – VS + MR Group)					
16.	KidI	MR/VS	55- emerging	70 – moderate	Improved (15)
17.	KidQ	MR/VS	65 – emerging	80 – moderate	Improved (15)
18.	KidR	MR/VS	45 – weak	60 – emerging	Improved (15)
19.	KidO	MR/VS	55 – emerging	70 – moderate	Improved (15)
20.	KidT	MR/VS	70 – moderate	90 - strong	Improved (20)

6.3.1 Group 1 – NE Group

The comparison of score results (as in table 6.1) revealed that five out of the six preschoolers in Group 1 (NE Group) were rather weak in critical thinking as revealed by the detailed score results of the PSCTST_ Pre-Assessment (See Appendix H). All except for KidS, the rest of the five members in Group 1 scored between a scale of weak or emerging for the skills of ‘analysis’ and ‘inference’. This indicated that preschoolers in Group 1 might be weak in the cognitive skills for analysing or making correct inferences. They required further support such as practices through thinking activities for developing these two cognitive skills of critical thinking.

The post assessment of PSCTS results (Appendix I) showed that the preschoolers in Group 1 had improved significantly in these two cognitive skills after the ISM implementation. Most of the preschoolers in the NE group began to show the emerging or acceptable level of critical thinking while two of them have attained the level of moderate or quality critical thinking after going through the infusion lessons. From mostly weak level of CTS who lacked critical thinking ability, the NE group has made improvement of attaining the acceptable level of critical thinking. This strongly indicated that the thinking activities designed in alignment with their MI strengths had brought about the improvement in the critical thinking abilities of these preschoolers.

The NE group was facilitated by Teacher F. The selected preschoolers in this group seemed to appreciate the thinking activities and tasks which were related to nature, animals, plants and environment such as park, farm, jungle and sea. Thus, various thinking activities for Science, Mathematics and English lessons (of ISM) were designed to involve all these elements intentionally. Teacher F in her interview commented that the MI based thinking activities were very helpful in stimulating children in her group to associate critical thinking with the activities. She found that children in her Group had shown improvement in their critical thinking abilities after going through the thinking activities which were designed in line with the elements of their NE strengths.

> *"Yes. I do think that the MI activities were very **helpful** for the children. With the appropriate materials provided, children were able to **associate with more critical thinking during the activities** or tasks assigned to them. I can see that the children in my NE group shown improvement of their thinking skills at the end of the special lessons with the thinking activities designed for their MI strengths…"* (Teacher F, Interview, 23/11/ 2017)

This strongly indicated that the MI based thinking activities, as part of the infusion lessons which incorporated elements of natural phenomena, living things and environment around; provided the NE Group with stimulating thinking opportunities of interest close to their proclivities. This could have possibly contributed to the development of their CTS.

In addition, the scores result of the PSCTST_ Post Assessment further indicated that both KidS and KidF recorded a significant improvement with an increase of twenty points each. As compared to the scores result of the 'pre-assessment', both of them only achieved the 'emergent' level of critical thinking but have progressed to 'moderate' level of critical thinking in the 'post-assessment' at the end of the ISM. Teacher F further commented that both KidS and KidF had benefitted much from the guidance and support provided in the form of thinking routines by the teacher during the execution of the thinking activities in the group.

> "*...I felt that some of the children benefitted much from the thinking routines we (the teachers) provided during the thinking activities in the group like KidS and KidF…"* (Teacher F, Interview, 23/11/2017)

The excerpt on the comment made by Teacher F indicated that the guidance provided by teacher in the form of thinking routine during the group thinking activities was an added contributing factor towards the CTS development of the preschoolers in group 1. It was believed that the thinking routines provided the preschoolers thinking practices while they complete the thinking tasks in group such as in the case of KidS and KidF. The thinking routines in this context seemed to have provided the platform for teaching CTS explicitly to the children in this group.

6.3.2 Group 2 – LM Group

In general, LM intelligence and thinking are well associated especially so with mathematical and science activities (Armstrong, 2009). In this study, it was noticed that children in the LM group seemed to be very engaged with almost all the thinking activities assigned to them for all the three subjects: mathematics, science and English. The facilitator of the group, Teacher M who commented that the LM group was more analytical and logical in executing the task assigned as compared to NE group or MR and VS group. She observed that Group 2 notably displayed logical manner of thinking and was able to complete most tasks in a systematic and rational way.

> *"Children in my group were very engaged in all thinking activities…using MI to teach children to think is very effective especially through the MI grouping. I can see that children in the LM group displayed thinking in a more logical and systematic manner as compared to NE or VS group. They reasoned together to help each other think of solutions in a rational way."* (Teacher M, interview, 23/11/2017)

This implied that the LM group might have stronger proclivities towards cognitive aspects of critical thinking. They seemed to reason more on their interpretation and analysing of information, argued and deliberated in making inferences and evaluating the choices of answers or solutions.

Teacher M also noticed that the preschoolers in her group often helped each other to think of solutions or answers by offering some suggestions or ideas for the group members to consider. At times, it was noticed they might debate or argue with peers in the same group in defence of their own suggestions and ideas. This further implied that the preschoolers were applying critical thinking through analysing and evaluating their own ideas in defending what they think was correct.

> *"Yes. I observed that children when **discussed in groups** on the answers they (think) thought of, they '**debated**' and '**argued**' with their friends…."* (Teacher M, Interview, 23/11/2017)

In this study, the LM group was the smaller group of four preschoolers. The PSCTST_ Pre-Assessment scores indicated that the LM group members were potential critical thinkers with most of them (three out of four) displaying the emerging level of thinking and one displaying moderate level of critical thinking.

The LM related activities in the form of infusion lessons focused on elements such as logical, analytical, calculations, numbers and puzzles. The researcher observed that (See Chapter 5, Table 5.2: Observation Summary), the thinking activities which intentionally incorporated counting and classification of animals, number lines and chart or graph on objects helped to draw the greater interest of thinking for this group of preschoolers. This was reflected as preschoolers in this group worked on number lines for mathematics, making list or chart for soluble objects in science as well as classifications of farm or wild animals for English lesson.

The PSCTS _ Post-Assessment scores also indicated that the LM group showed a very significant improvement in the level of their CTS. There was a good increase of twenty (20) to twenty-five (25) points whereby all of them have excelled as moderate (three out of four) or strong (one out of four) critical thinkers. They were able to display quality critical thinking and made more effective decisions. It was worth mentioning that all the preschoolers in this LM group demonstrated high level of critical thinking faring well in all the four cognitive skills of interpretation, analysis, making inferences and evaluation.

The improvement in the level of CTS for LM group (as indicated in the comparison of scores results) revealed that MI based thinking activities have the impact of enhancing the CTS development among these preschoolers. The LM activities appeared to have served the purpose of sharpening and strengthening the development of CTS for the preschoolers concerned.

6.3.3 Group 3 – VL Group

The VL group was noticed to have enjoyed the group discussions most of the times as they discussed together on ideas and suggestions put forth by group members. Preschoolers in this group being strong in verbal-linguistic were observed to have articulated their thoughts and ideas well. The VL strength was believed to have enabled the group members to understand the information or data provided. They communicated their ideas across better than other groups and they seemed to be able to reach certain decisions or answers more promptly as commented by their group facilitator (class teacher, Teacher N), that she noticed her group of preschoolers worked well together and were able to solve problems in a common channel of communication in reasoning and analysing of the information available as well as inferences made by using the their language strengths together in collaboration. The ability to better communicate make critical thinking more possible among the members in the VL group as they discuss and deliberate their own points of views.

> *"…MI way of teaching is very helpful to teach thinking skills. Activities which were planned in accordance to children's MI – they can think better to solve problem in the same way…children in my VL group were able to communicate better as they are strong in verbal-linguistic…they used their language skill to reason and analyse the information they had."* (Teacher N, interview, 23/11/2017)

The VL group activities were designed with the linguistic strategies in mind involving more open-ended language activities in the thinking tasks to be more effective in imparting the meaning of the information and to tap on the linguistic strength of the members concerned. The VL based thinking activities included: short stories, written/verbal descriptions, brainstorming and writing of sentences or short paragraphs. Preschoolers in this group were required to understand the information or descriptions before discussing and deliberating the suggestions or answers from fellow group members. The VL group of preschoolers were rather strong with the interpretation and analysis skills in general. Teacher G (facilitator of Group 4) commented that she had observed that the preschoolers in Group 3 (VL Group) were constructing words and writing of sentences to express their ideas and answers as per required by the instructions of the tasks as compared to preschoolers in Group 4 (VS + MR Group) who preferred visual expressions.

> "*In most of the activities, children in the VL group chose to write their answers in words while children in my group don't spell or write so well, they preferred to draw or match pictures…"* (Teacher G, Interview, 23/11/2017)

The score results of PSCTS _ Post-Assessment indicated that the preschoolers in VL group were potential moderate or strong critical thinkers who required a platform for them to develop CTS in the classroom. This could be due to the fact that these skills require more of the linguistic abilities. The post assessment result showed that all of them recorded a significant improvement in their CTS level particularly so in the evaluation skills. This meant that most of them began to display stronger ability in assessing the choice of decisions made and to examine the accuracy of the answers or solutions they produced after the ISM implementation. All of them displayed either moderate of strong critical thinkers and were capable of quality critical thinking or even to perform advance critical thinking who most of the time made accurate decisions.

Besides, language strength can be an advantage for critical thinking as children to use language (verbal or written) to represent or communicate their ideas more confidently and thus provided them a means for thinking in depth about their thoughts while they were exposed to the thoughts of others (Robson, 2012). This means that the language strength can act as the bridge for the preschoolers of the VL group to understand or reflect on (internalised) their own thinking while making comparison and contrast (reasoned) with the thoughts of others before articulating their own thoughts.

In short, the critical thinking ability of VL group was strengthened as internalisation and reasoning of thoughts as well as decisions making take place in the form of group discussions through executing the thinking tasks or activities assigned.

6.3.4 Group 4 – MR and VS Group

In this study, the VS and MR group comprised of preschoolers who were strong in visual-spatial intelligence and musical-rhythmic intelligence. The thinking activities for this group of preschoolers centred on the musical aspects such as rhythm, raps, songs, chants as well as the spatial aspects such as drawing, colouring/painting, designing and graphic. Most of the thinking activities in this group were meant for individual execution with two or three group activities being completed in group.

Typically, the preschoolers of VS and MR group were more inclined towards creativity either musically or spatially. In contrast to musical and spatial strengths which are identified as creative activities, thinking or critical thinking is a cognitive activity. While some may argue that creative abilities and cognitive skills are two contrasting skills, others claimed that they are two sides of a same coin (Oxman-

Michelli, 1992). Interestingly, creativity is known to associate with generating ideas while critical thinking is associated with judging them (Bryant, 2017). This seems to imply that creative individuals might be the potential critical thinkers who could be trained as good critical thinkers.

In line with the purpose of this study, the implementation of MI based thinking activities were designed to allow the preschoolers to tap on their MI strengths (here in this context, the musical or spatial intelligences) to help them develop their weaker MI (in this case, the logical intelligence of critical thinking). Thus, the spatial or musical related thinking activities were intended to encourage the preschoolers to interpret, analyse and making possible inferences as solutions to the thinking tasks.

The facilitator of MR and VS group, Teacher G described her observation that the preschoolers in her MI group were somehow not strong in language (VL) which was required for internalising the thinking and logical reasoning (LM) for analysing and inferring the possible solutions. She claimed that with the MI based activities designed for the group, preschoolers in this group were able to learn to express their ideas and thoughts through non-logical or non-linguistic activities such as chants, raps, rhymes or snapping of fingers as well as colouring, drawing, graphs and designing.

> *"In my MI group, the children are not good at reading and writing but they enjoyed working with the thinking tasks in ways where they can use chants or drawing to describe their ideas…"* (Teacher G, interview, 23/11/2017)

In this context, the preschoolers were believed to relate critical thinking with musical elements or picture metaphors (Armstrong, 2009) while solving the group thinking tasks. For example, in Lesson 5 of Mathematics (Classroom Observation: video: MAH 00333 – 00:21-00:52, 9/11/2017- see Appendix T), the thinking activity of knowing the total value of 20 sen and 50 sen; preschoolers in MR and VS group were observed to have related better using the pictorial coins instead of verbatim or numerical amount. They were able to understand the value of money (in ‘sen’) and solved the total amount of seventy sen (RM0.70) through colouring the pictorial coins.

As indicated in the comparison of PSCTST score results, it was observed that after going through the MI based thinking activities of CTS infused lessons, all the five preschoolers of the MR and VS group recorded a satisfactory improvement in their CTS levels. An improvement of fifteen to twenty points averagely were achieved by each of the member in this group as revealed in the post assessment of PSCTST. In addition, one of the members of the MR and VS group, KidT achieved the level of *strong* critical thinking after the intervention of infusion lessons as compared to the level of moderate critical thinking prior to ISM implementation. This further implied that the thinking activities which were designed in relevance to the musical-rhythmic and visual-spatial strengths of the preschoolers have a significant impact in the development of CTS among the selected preschoolers of the MR and VS group.

6.4 The MI Approach in Relation to Improvement of CTS

The instructional approach which is MI based allows the teachers to teach the core thinking skills in a variety of ways (Zobisc et al., 2014) that draw upon the specific strengths of the learners. Data collected from the interviews conducted with the facilitators/teachers for the various MI groups, indicated that the MI grouping of children was an advantage which allowed them to work together better as in groups as they spurred one another to think of solutions for the problem tasks assigned.

The class teacher (Teacher N) noticed that children (preschoolers) in the same MI group tend to ‘work together’ and ‘think together’ more collaboratively and effectively on the assigned thinking activities which were more promising towards their areas of strengths (Gardner, 1993) as they helped each other to think of solutions in much similar ways and came up with answers for solving thinking tasks at a faster rate. Below is the except of Teacher N's interview.

> *"…MI way of teaching is very helpful to teach thinking skills. As activities were planned in accordance to children's MI – they can think better together to solve problem in the same way…"* (Teacher N, interview, 23/11/2017)

Teacher M consented to the observation of Teacher N stating that she found MI was an effective strategy for teaching children to think. Children in the various MI groups were seen working together harmoniously in solving problems. This indicates that the MI approach was an advantage for enabling children solve problem better together. See the excerpt of the interview below.

> *"…using MI to teach children to think is very effective especially through the MI grouping. I can see that children in the same MI group worked together harmoniously and help each other think of solutions faster."* (Teacher M, interview, 23/11/2017)

Both Teacher G and Teacher F commented that they found that the preschoolers could learn critical thinking better and work better with thinking tasks when they were assigned activities or given materials which they could relate better (as in accordance to their strengths). They expressed that children did not necessarily learn to think critically through some fixed ways such as reading and writing. They could think and express or describe their thoughts through their own preferred ways. (See the excerpts below.)

> *"MI ways help a lot…Children can learn critical thinking better when they are given materials which are of interest to them. For example, the NE group loves the materials which are related to nature."* (Teacher F, interview, 23/11/2017)

> *"In my MI group, the children are not good at reading and writing but they enjoyed working with the thinking tasks in ways where they can use chants or drawing to describe their ideas…"* (Teacher G, interview, 23/11/2017)

Based on the above observations and feedback from selected teachers, there is a strong implication that the adoption of MI approach for teaching CTS have enhanced and contributed to the effective learning and development of critical thinking among selected preschoolers. Thus, it resulted in a significant improvement of CTS among those selected preschoolers as illustrated in figure 6.7.This finding supports the results of previous studies by Zobisch et al. (2015) and Ali Abdi & Maryam Rostami (2012) that the MI instruction is effective for teaching CTS which resulted in the improvement of CTS development among the learners.

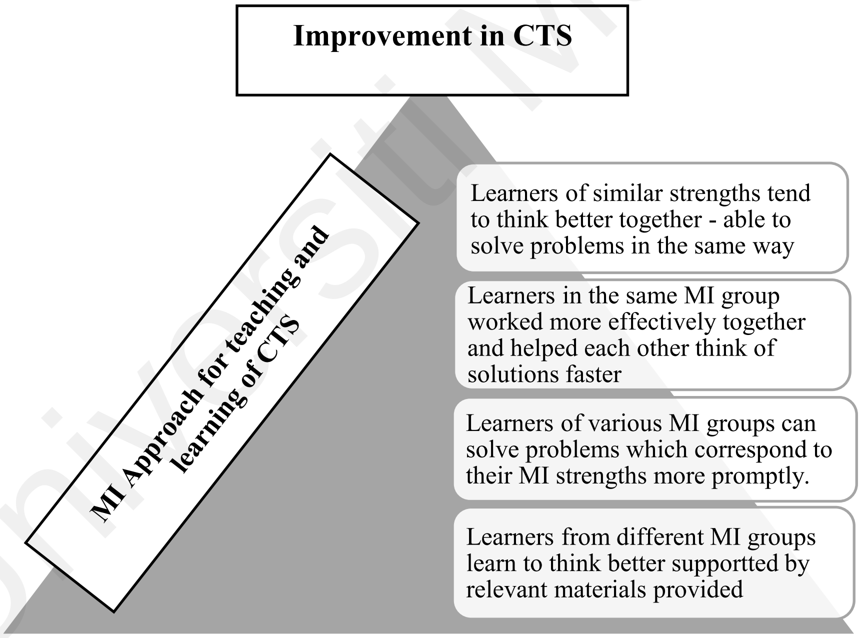


Figure 6.7 MI Approach enhanced effective learning and development of CTS

6.5 Summary of CTS Development in Various MI groups

In relation to Howard Gardner's MI theory (1983, 1993, 1999) and numerous studies on MI as an approach to CTS teaching (see chapter 2, section 2.6.3); MI was opined as one of the more effective instructional strategies for teaching critical thinking.

Analysis of data from observations and teachers' feedback indicated that the MI approach has a significant impact on the teaching of CTS. Furthermore, the MI approach which addresses various learning propensities of the learners is an effective instructional strategy. This approach seemed to have enhanced and accelerated the learning and development of critical thinking as proposed in this study.

The thinking activities and tasks for this study were designed with respective MI focus to enhance the teaching and development of CTS in the various MI groups. In this context, teaching and learning of CTS was made available through various modalities which support the notion of preferred learning in accordance to various MI strengths of the preschoolers. For example, the NE Group (Group1) would be assigned thinking activities or tasks of focusing on elements related to nature, animals, plants, environment and ecology awareness.

Through the observations and teachers' interview, all preschoolers in various MI groups were seen to have shown significant improvement in their CTS after going through the fifteen hours of infusion lessons where thinking tasks were designed to support the MI of each group. Preschoolers in each MI group were found to be very actively engaged and they enjoyed the lessons delivered by their teachers. The enthusiastic participation of the preschoolers in completing thinking activities collaboratively and individually encouraged the development of cognitive skills of critical thinking particularly: interpretation, analysis, inference and evaluation as per the purpose of this study.

It was also noticed that, the facilitation provided by the teachers for the respective MI groups also played an important role in scaffolding the development of CTS among the preschoolers through consistently creating the 'thinking challenges' climate and providing guidance to the preschoolers in the process of executing the thinking tasks.

There were also evidences that preschoolers of the different MI group expressed their solutions in forms which are reciprocal to their strengths. For example, the LM (Logical-Mathematical) group would prefer to express their ideas of solution in the form of tables and graphs such as number-line while the NE (naturalist-environmentalist) group enjoyed sharing ideas of solution related to recycle or nature issues.

The next section discusses on the application of acquired CTS for solving problems by the selected preschoolers as the learning outcomes of the development of CTS through infusion lessons or ISM implementation.

6.6 Application of Acquired CTS for Solving Problems

The literature review in chapter 2 (section 2.7) highlighted that the outcome of teaching CTS and the evidence of CTS acquirement is projected in the aspect of applying CTS for problem solving. CTS is often associated with problems solving skills.

To answer research question 4, “How is the CTS acquired among the selected six-year-old preschoolers of Trinity Kids applied for problem solving?”; three problem-solving tasks were prepared and assigned to the preschoolers in the various groups at the end of the ISM implementation. These tasks were designed with ‘open-endedness’ to challenge children to interpret the problem, analyse information, make possible inferences and evaluate the choices made more in-depth in the cognitive aspects. The preschoolers were required to solve those problems either individually or collaboratively as a group.

Taking into consideration that preschoolers learn and think best with problems which are meaningful for them, the tasks were designed in relation to the three subjects of English, Mathematics and Science (illustrated in Table 6.2).

Table 6.2
The Problem-Solving Tasks Sheets

Task Sheet	***Task Instructions***	***CTS Applications***
Task 1 (English) Group project	***"Who am I?" -Guess what animal is this?*** *Instruction:* Each group is given a task-sheet with descriptions of two animals respectively. Children are to read through and understand the descriptions with the help of the teacher or facilitator. Children are to discuss the descriptions and think or guess the possible animals described in their respective groups. Group members are to reason and evaluate their choice of answers. Each group is to explain how they obtain the answer or solve the task.	Children are to: • understand ***(interpret)*** the information and instructions required of the tasks assigned • compare and examine ***(analyse)*** the evidences or information available to determine certain patterns of relationship
Task 2 (Science) Group Project	***How to find out the two poles of the black magnet?*** *Instruction:* Each group is given a black magnet without the indication of 'N' or 'S' besides a U-shape magnet and a compass. Children are to discuss and think of possible solutions to determine the 'poles' of the black magnet. Children are to deliberate on their ideas and examine each other's suggestion. Each group is to indicate the 'N' and 'S' 'poles' by using stickers. Each group is to share how they solve the problem.	• identify and examine details to form ideas or suggestions and to draw possible conclusions ***(inferences)***
Task 3 (Maths) Individual Project	***What topping can I choose for my ice-cream?*** *Instruction:* • Each child is given a task sheet with details of cost for an ice-cream and various toppings such as: chocolate, cashew nuts, cherry, wafer, chocolate sauce and chocolate sprinkle. • Teacher at each group is to explain the task clearly to all the children. • Each child is to think on the choice of topping combinations for their ice-cream if they have: (1) RM 2.00 (2) RM 3.00 • Children are to record the choices of topping combination on the task sheet and share their reasons for choices with their group.	• assess and explain the validity or acceptability of the ***(evaluate)*** decisions or solutions concluded

The three problem-solving tasks were specifically designed to incorporate the four cognitive skills of critical thinking as illustrated in Table 6.3. to enable selected preschoolers relate the CTS they have acquired from the ISM implementation for solving the problems of the tasks assigned.

Table 6.3
The Components of CTS in the Problem-Solving Tasks

Problem-solving Task	**Critical Thinking Skills**			
	Interpretation ***(understand the meaning of instruction)***	**Analysis** ***(verifying evidences and identifying possible relationship)***	**Inferences** ***(identifying possible answers or solutions)***	**Evaluation** ***(verifying validity of choices and answers)***
Task 1 (English)	√	√	√	√
Task 2 (Science)	√	√	√	√
Task 3 ***(Mathematics)***	√	√	√	√

Going through the process of solving the three tasks assigned, selected preschoolers would be required to:

1. Read through the requirement or instruction of the tasks to identify and understand the question or nature of each problem (interpretation).
2. Compared analysed the information provided in the task sheets individually or discussed as a group (analysis).
3. Identified and examined details to form possible suggestions or solutions for the problem posed (inference).
4. Assessed and verified the accuracy of the choice of answer and solution as well as to explain the reason for choices made (evaluation).

This implied that through the problem-solving process, selected preschoolers would be applying the four core skills of critical thinking interpretation, analysis, inference and evaluation. The application of logical interpretation, analysis, reasoning for inferences and the ability to evaluate critically will lead to production of multiple solutions (King & Zhang, 2014). In other words, application CTS are required for problem solving and that CTS application culminated to a product of an answer to the question or a solution to the problem (Robson, 2012).

Teacher N commented that the use of a fixed pattern of questioning or setting the thinking routines were very helpful for selected preschoolers. As discussed in section 6.2.6, a thinking routine was instrumental in guiding the preschoolers for critical thinking through a consistent thinking pattern. Thus, the preschoolers were able to apply a pattern of critical thinking to solve problems.

> *"… I found that asking the four question frequently in a fixed pattern helped the children to think in a consistent manner (thinking routine) very useful. Now, they used this pattern for the problem-solving tasks…"* (Teacher N, Interview, 23/11/2017).

The Principal, Teacher G also observed that the preschoolers were more experienced to solve those problems assigned to them. They were seen using the guide of the questions pattern or thinking routine to help them understand the task and analyse the information provided to make a few possible inferences or answers.

> *"… I could see that the children were much ready to solve those tasks assigned. They were using the four questions pattern as a guide…they discussed on the possible answers from the clues given…"* (Teacher G, Interview, 23/11/2017)

The researchers also observed that the teacher constantly reminded the preschoolers to ensure they understood the task requirement and check through all the information before they draw the possible solutions. (Observation_ video: MAH00356 – 00:04 -00:33 minutes, 14/11/2017- Refer to Appendix T).

This further indicated that consistent questioning techniques and thinking routine related to the four core cognitive skills served as a 'guide' in helping selected preschoolers apply CTS for solving problems. In other words, application of CTS was evident while the selected preschoolers engaged in the problem-solving tasks guided by the thinking routines.

6.7 Problems Solving Process and Critical Thinking

Problems solving requires interpretation, analytical, reasoning and evaluation skills to produce solutions which in turn involves critical thinking skills (Fisher, 2001). In the context of this study, the problem tasks assigned to preschoolers called for the application of cognitive abilities to interpret, analyse, infer and to evaluate. In short, problems solving requires the application of critical thinking skills.

While observing the selected preschoolers going through the problem-solving process (See Appendix M_ classroom observation protocol: Part F – 3), the researcher noticed that the preschoolers in every group were more confident to work on the problem-solving tasks after going through the infusion lessons. They readily took on the tasks (from the task sheets) and worked on solving the tasks. Teacher F, (Facilitator for NE Group) commented that the preschoolers were readily engaged in reasoning and evaluation (thinking mode) as they worked on the tasks assigned to them.

> *"…the children in my group were readily going into the thinking mode, they reasoned and examine their answers against the clues (information) provided...when I gave them the task sheets…"* (Teacher F, interview, 23/11/2017)

Teacher M also observed that the preschoolers often paused for some forms of deliberation instead of providing immediate responses or answers when the facilitators or teachers posed them several questions which spurred them for more in-depth thinking and for more suggestions or answers. For example, the teachers/facilitators would ask members of the group, “What does this question mean?” and “Is this answer correct, why?” or “Are there any other answers?”. The selected preschoolers would take time (pause) to examine the meaning of the questions with their peers before they discussed on the possible inferences.

> *“…during the problem-solving session, children were seen to take some time for checking with one another on what the question mean … then they discussed on the possible answers…”* (Teacher M, Interview,14/11/2017)

The pausing for deliberation and reasoning of the preschoolers was believed to be related to the cognitive aspects of the thinking process. The next section described further on the process of solving the various problems or tasks.

6.7.1 Problem Solving Task 1

Task 1 (Appendix U) was a group thinking activity. After the general instructions given by the teacher, the researcher observed that (classroom observation_ video: MAH 00357- 00:04-012:27 minutes, 14/11/2017) the preschoolers in the respective groups took time for reading through the information or clues provided for Task 1 carefully and articulated their ideas to the facilitator and among the group members. In the group, selected preschoolers examined the requirement of the question and the clues provided to help each other understand the descriptions on the clues of various animals in the task sheet concerned. The group members were observed to have deliberated on the most prominent clues for inferring the possible names of those animals described. For example, Group 1 (NE group) was reasoning and evaluating on three most prominent clues which led them to predict and guess the correct name of the animal concerned, “It is a hippopotamus.” The group was able to provide reasoning and explanation for their choice of answer, such as: (1) it is grey, (2) it has big mouth, (3) it lives in the water. In this regard, KidF explained (excerpt below from video: MH 000357: 08:12-09:11 minutes, 14/11/2017- interview on Task 1) that his group has evaluated and compared all the clues with another grey big animal with big mouth, the 'elephant' before they confirmed their choice of answer as 'hippopotamus' through the most prominent clue of "It lives in water".

> "*My friends and I compared all the clues and checked (evaluate) them. We chose 'hippopotamus' as our final answer because one of the clues says, 'it lives in water'. Elephant is grey and it has big mouth but does not live in water" (*KidF, Interview, Task 1, 14/11/2017)

In the context of this study, the examination and analysis of clues and deliberation on the possible answers helped the group members to compare and re-examine the suggested answers against the descriptions (clues) before finalising and deciding on the final answers. Teacher G (facilitator of group 4) elaborated that she would pose questions such as "Which clues help you to determine your choice of answer clearly?" "Why did you choose this answer?" to help preschoolers re-examine or evaluate all the clues with their peers before making a choice answer. (Refer to Appendix T for the sample transcript of Teacher's Comments).

> "*I would pose questions to my group for them to rethink, re-examine and evaluate all the clues before they pick their final choice of answer…"* (Teacher G, Teacher's Comments, Task 1, 14/11/2017)

Overall, the four groups were able to provide the correct names of the animals through interpreting and analysing the clues provided accurately, evaluated the inferences made and deliberated on the suggestions before confirming the correct answers. This observation implied that the preschoolers were applying the four core skills of critical thinking in solving task 1.

The deliberation to understand, compare, re-examine and analyse of the given clues to make possible inferences as well as to reason and evaluate the choices of answers are among the important core component skills of critical thinking (Lai, 2011).

This strongly indicated that when preschoolers were involved in solving problems as in the thinking task, they actually applied the various cognitive skills of critical thinking.

6.7.2 Problem Solving Task 2

For Task 2 (Appendix V), a group task; the researcher observed (observation: video: MAH 00369- 0:01-1:52 & MAH 00370: 0:01-1:53, 14/11/2017) that the preschoolers of various groups were discussing on how to determine the two poles of a magnet based on the information and properties of the magnets which they have learnt in Lesson 4 of the Science infusion lesson. In the respective groups, preschoolers were looking for indicators to determine the two 'poles' of the unindicated 'black' magnet through examining the properties and making comparison with the U-shape magnets (of which poles were indicated). Teacher M explained that her group examined and deliberated whether the black magnet (poles unindicated) will "push each other away" (repel) or "pull together" (attract) when it was placed near to the U-shape magnets. The characteristics of 'repelling' or 'attracting' were used by the preschoolers to determine the 'North' and 'South' poles of the black magnet.

> "*... The children first checked and confirmed the poles on the 'U-shape' magnet before testing the 'black magnet' against it. They examined if the magnets pushed each other away or pulled together. They could then tell which side of the black magnet is the 'North' or the 'South'..."* (Teacher M, Teacher's Comments, Task 214/11/2017)

This implied that the selected preschoolers were using their reasoning skills to compare and contrast based on what they have learnt about the properties of the magnet. They analysed and evaluated their observation of whether there was a repellent and attraction before determining the 'poles' of the black magnet.

Teacher F expressed that she was happy with her group (NE Group) that they could reason and analyse in this simple process of determining the 'poles' of the magnets. This showed that children in her group were able to think more analytically and logically to solve problem just like the other groups. In other words, the preschoolers in the selected classroom were able to apply critical thinking for problem-solving.

> "*I'm glad to see that children in my group were able to reason and analyse in order to determine the poles of the magnets…this showed that they are using critical thinking more now for solving problems…like the other groups...*"
> (Teacher F, Teacher's Comments, Task 2,14/11/2017)

All the groups were observed to be able to present their reasons and justification on how they determined found to have solved Task 2 successfully based on what they have learnt in Science, Lesson 4. When asked how they find out the poles of the unindicated black magnet; KidO and KidT described their finding process and justified their reasons as the excerpt below (Interview, Task 2,14/11/2017):

KidO:	*We first confirmed the poles of the U-shape magnet. The red side is N (North pole) and the white side is S (South pole).We placed one side of the black magnet next to the red side (N) of the U-shape magnet to see if it attracts or is 'pushed away'. If it attracts, then we know that side is the south pole.*
KidT:	*We also tested by placing the other side of the black magnet to the red (N) side again.*
Interviewer:	*What happened then?*
KidT"	*It was pushed away. Then we know it is the north pole. Same poles pushed away (repelled).*
KidO:	*We put a white dot to show (indicate) that it is the north pole. The other side (with no dot) is the south pole.*
Interviewer:	*Are you sure?*
KidT:	*Yes, we learnt this in the Science lesson*

This showed that the preschoolers gauged their answers against what they have learnt earlier. It further indicated that the selected preschoolers applied the CTS based on the existing level of their learnt knowledge and to increase the level of their thinking abilities in order to find the solution to a problem concurred with the findings of the studies conducted by Davis-Seaver et al. (1998) as well as Ertmer and Newby (2013).

6.7.3 Problem Solving Task 3

Task 3 (Appendix W) appeared to be more challenging for the preschoolers as an individual task which was mathematical in nature. The preschoolers were observed to have taken more time to read and interpret the instruction and requirement of the task assigned to them. The task required them to understand the values of money and to carry out mathematical operations such as addition and subtraction for working out the choices of 'ice-cream toppings' within the given value of money. Both KidA and KidH explained how they worked out the various combination in the excerpts below:

> *"With RM 2.00, I first put aside RM 1.00 for the ice-cream. Then I have RM 1.00 left. I chose the chocolate bar which is exactly RM 1.00."*
>
> *"With RM 3.00, I put aside RM 1.00 for the ice-cream. I have RM2.00 left. I again chose chocolate of RM1.00 and I chose cashew nuts which cost another RM1.00."* (KidA: Interview, Task 3,14/11/2017)

While KidA made a straight-forward choice of combination, presented a more complicated choice of combination:

> *"With RM 2.00, I will spend RM1.00 for the ice-cream and chose the toppings of cherry (30 sen) and wafer (20 sen). With the balance of 50 sen, I chose chocolate sprinkles. That is the total of RM 2.00."*
>
> *"With RM3.00, I will spend RM 1.00 for the ice-cream, and I chose chocolate bar and chocolate sprinkles which cost(ed) total RM 2.60. I had a balance of 40 sen and I chose two (2) wafer which costs 20 sen each. Now I have spent all the RM 3.00."* (KidH: Interview, Task 3,14/11/2017)

This implied that the selected preschoolers applied logical reasoning and analytical skills to deliberate on the possible inferences of topping combinations with the details and information provided to make the best choice of decisions or solutions.

The preschoolers were also observed to be able to solve the problem when teachers provided them the 'toy money'. Both Teacher N and Teacher M commented that the problem-solving tasks were rather abstract for most of the preschoolers. They were only able to solve the problem more promptly when they were provided with the physical 'toy money' instead of the abstract phrase of RM 2.00 or RM 3.00 as illustrated in the excerpt below:

> *"...it helped so much when we provided our children the 'toy money'... they could relay better and were able to solve the tasks more promptly…"* (Teacher N and Teacher M: Teacher's Comment, 14/11/2017).

Based on the answer sheets collected, it was revealed that seventeen out of twenty (17/20) preschoolers were found to have solved task 3 with both sub-tasks correctly while the other three (3) of them only managed to solve one sub-task of the problem correctly. Analysing the answers (from the answer sheets) provided by the preschoolers, it was worth mentioning that most of the choices and combinations of 'ice-cream toppings' suggested were different from one another. Almost none of the choices provided were the same. This showed that although the same CTS was applied by various preschoolers to solve the task, yet the solutions or inferences made could be manifold. In another words, it implied that although each preschooler may learn CTS through the same 'approaches' yet they all think in different ways (Kagan, 2000). This finding corresponds with the claims made by Gardner (1983) that children's minds are different from one another and thus they think in different ways.). This finding corresponds with the claims made by Gardner (1983) that children's minds are different from one another and thus they think in different ways.

6.8 Summary of CTS Application for Solving Problems

In all the three tasks, it was observed that majority of the preschoolers (seventeen out of twenty) were able to solve the problems or tasks assigned successfully. The findings of this study suggested that the preschoolers were able to apply CTS for interpreting the requirement of tasks and analysing the information before making inferences and decisions for solving the new thinking tasks or problems. This finding is confirmed by Lai (2011), that the application of CTS in solving problems or new problems is more possible than the transferring to other new disciplines.

As part of the group discussions process, the preschoolers were also involved in assessing or evaluating the validity and accuracy of the answers and solutions of their choice. The preschoolers in various groups were seen demonstrating the ability of evaluating their choice of answers before agreeing upon accepting them as solutions.

In addition, through the above findings, it was noticed that although all preschoolers may have learnt CTS through the same 'infusion approach' yet they do not think in the same way. This further implied that these children think in different ways which may be due to their different areas of strengths towards thinking and learning as per suggested by Gardner (1993) and Kagan (2000). It was interesting to note that the different ways of thinking might result in different outcomes or solutions.

The finding of this study also strongly indicated that the explicit teaching of CTS through MI approach has positively led to the development of CTS among selected preschoolers in that they demonstrated the process of more in-depth thinking or in another word, critical thinking; when they were completing the thinking tasks and solving the problems (as in the task sheets). This finding is in line with the claims made by Halpern (1998), Taggart et al. (2005), and Robson (2012) that children demonstrate their critical thinking abilities when they are given the opportunity to solve everyday problems as discussed in section 2.7. Figure 6.8 (in the following page) illustrates how critical thinking took place as selected preschoolers were engaged in problem solving.

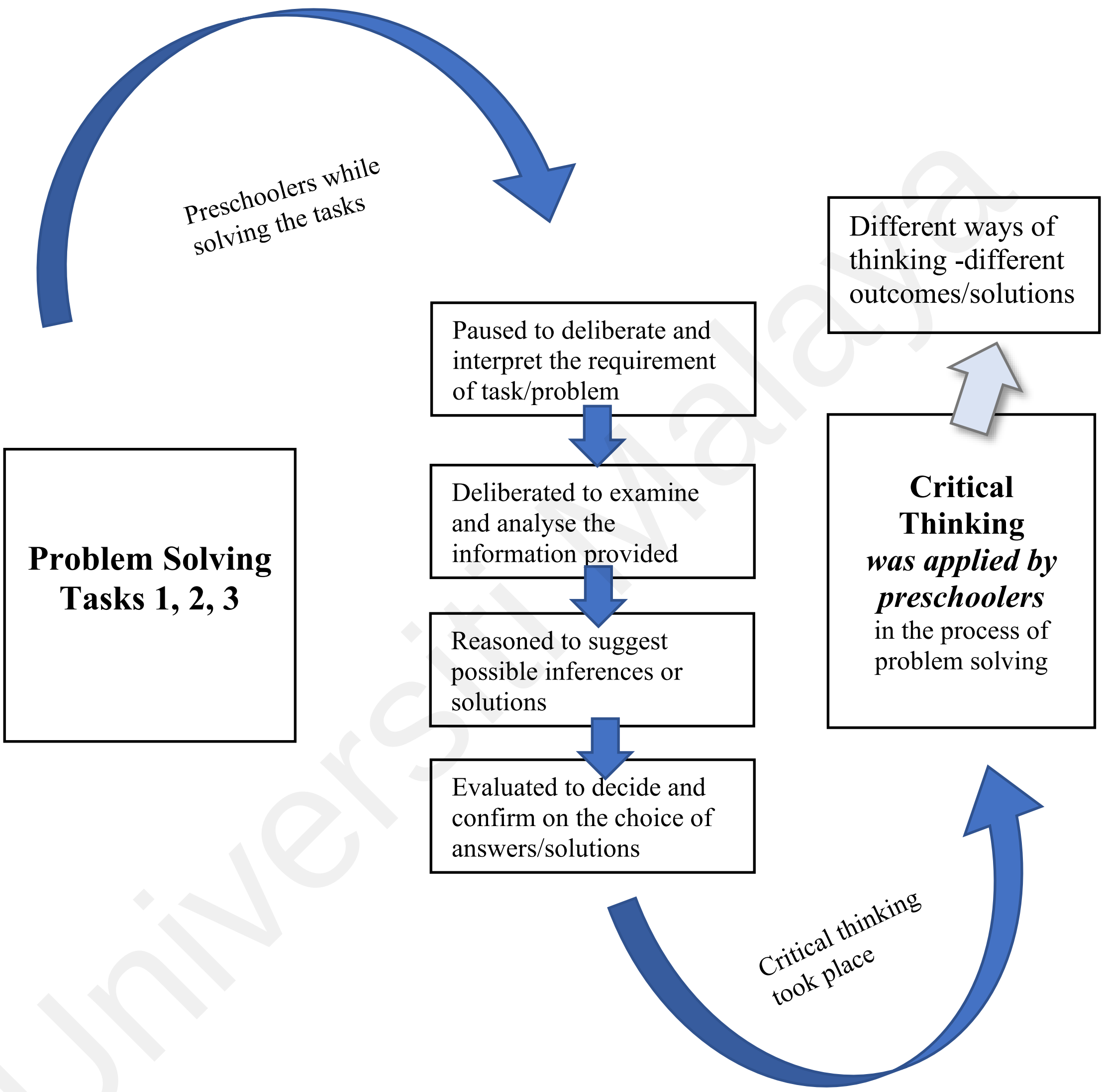


Figure 6.8 Critical thinking took place in the midst of solving problems by selected preschoolers

6.9 Summary of Chapter

The findings and discussion presented in this chapter concern the development of CTS among the preschoolers and how CTS were applied by them in solving problem tasks. Through the findings of this study, six factors which could have possibly related to the development of CTS of young children were described in sections 6.2.1-6.2.6.

The readiness of the young preschoolers towards learning to think more critically is believed to be related to their potential as critical thinkers. The instructional support from the infusion lessons of the ISM was seen to have created the platform for in-depth thinking or CTS to be taught explicitly in the preschool classroom. Besides, scaffolding provided through collaboration of peers and guidance by teachers supported the social constructivism aspect of CTS development while the thinking routines created by the teachers supported the cognitive constructivism aspect of CTS development. Through the thinking activities of the ISM implementation, teachers were able to create thinking climate to challenge critical thinking in the classroom which further promoted CTS development among the selected preschoolers. The MI instructional approach enabled the interplay of various MI which fostered more effective collaborative learning and thinking among selected preschoolers who shared similar MI strengths in the MI groups.

Specially designed MI based teaching and thinking activities provided the platform for CTS to be developed through multiple modalities. The outcome of PSCTST assessment whereby preschoolers in the respective MI groups were found to show significant improvement in their CTS levels. This was evident that the preschoolers benefitted from the MI activities which are inclined to their various MI strengths.

Critical thinking is closely related to problem-solving. As an essential tool for decision making and solving problem, the application of CTS for solving problems served as the indicator that CTS development occurred in the young preschoolers as the learning outcome of the delivery of CTS infused lessons from the ISM.

Through the problem-solving tasks assigned, selected preschoolers were required to interpret the requirement of task, deliberate to analyse the information provided, reason to suggest possible inferences and evaluate to confirm the choice of solution. This indicate that CTS was applied by selected preschoolers while solving problems.

The next chapter presents the implications, the conclusion of this study and the suggestions for future study.

CHAPTER 7

SUMMARY, IMPLICATIONS AND CONCLUSIONS

7.1 Introduction

Over the years, numerous studies conducted by thinking experts focused mainly on the teaching and development of CTS for older or adult learners. However, some recent studies on the potential and possibility of young children being critical thinkers gave rise to some directions for the researcher of this study to conduct an exploratory case study on the development of CTS for preschoolers. As such, this study focused upon the exploration of the CTS development among selected six-year-old preschoolers.

For the purpose of this study, the researcher opted for the infusion approach and the MI instructional strategies for teaching CTS to selected preschoolers in Trinity Kids, the preschool which adopts MI approach for teaching and learning. Furthermore, this study holds the view that the specifically designed MI based thinking activities for the infusion lessons (ISM) would benefit the preschoolers in the ways that they are able to learn the core cognitive skills of critical thinking through activities which are in proclivity with their MI strengths.

Through exploring the teaching and development of CTS, the researcher hopes that the findings of this study can provide a deeper understanding about the process of CTS development among preschoolers. It is also hoped that the findings of this study can provide suggestions on the appropriate materials for supporting preschool teachers in teaching CTS to children in the preschool classroom.

The next session discusses the overall summary of this research's findings and its implications on preschool education and CTS development of preschoolers. This chapter would also provide suggestions for future studies and finally the conclusion.

7.2 Summary of Findings

This current research explored the CTS development among selected six-year-old preschoolers at Trinity Kids. Learning to think critically is a new skill for the preschoolers while infusion teaching of CTS to young children is a new experience for the preschool teachers. Thus, in support of the learning and teaching of CTS, a set of Instructional Support Materials (ISM) was prepared.

This study aimed to achieve four research objectives and to answer four research questions. Firstly, through the methodologies described in Chapter 4 and through the discussions with selected teachers on the preparation of ISM described in Chapter 5; the researcher has drawn up a framework for the ISM to be developed. Specific elements were identified and incorporated into ISM framework for the purpose of teaching CTS explicitly to selected preschoolers in Trinity Kids. The ISM was basically designed based on the Swartz' and Park's (1994) infusion model. Four core skills of critical thinking (interpretation, analysis, inference and evaluation) was infused into the existing Trinity Kids K2 curriculum. MI based thinking activities were among the elements of the ISM framework in line with the main aim of this study. Importantly, for this study, ISM was to fulfill the purpose of an 'intervention programme' for CTS to be taught to preschoolers and be developed among preschoolers. With the framework of ISM clearly described, research objective one (1) was achieved and research question one (1) was answered.

Secondly, findings from data collected indicated that the infusion lessons were effectively implemented in the selected Trinity Kids classroom. The implemented lessons were effective in drawing the interest of selected preschoolers towards learning to think critically. As preschoolers enjoyed the interesting lessons, they were stimulated to learn to 'think in-depth'. The researcher found that a few factors have contributed to the effective implementation of infusion lessons (ISM). These included the conducive learning environment which encouraged critical thinking among the preschoolers and the experienced and well-trained teachers who provided appropriate support as well as conducted the interesting MI based thinking activities which were stimulating for the selected preschoolers.

The results of this study further suggest that the effective implementation of ISM, was believed to have contributed to the CTS development of the selected preschoolers. This deduction was drawn upon observing the ISM implementation for eight weeks in the preschool classroom. Findings show that teaching CTS explicitly through MI based teaching activities to the selected preschoolers who were placed in various MI groups showed enhancing results. The selected preschoolers in respective MI groups with the same MI strengths were found to be able to think and collaborate effectively together in learning and thinking as well as in solving thinking tasks. The data collected indicated that the preschoolers in the various MI groups seemed to think and expressed their thoughts in their own preferred ways. For example, the LM group did not have to express their thoughts in linguistic ways such as stories and writing sentences but instead they expressed through presentations of graphs and numbers. Outcomes of these findings further accomplished research objective 1 and addressed research question 1.

Thirdly, through contrasting the PSCTST scores of both the pre-assessment and post-assessment; the result revealed that there appeared to be a notable improvement in the levels of critical thinking among all the selected preschoolers after the implementation of ISM. All the selected preschoolers have displayed improvement in their CTS levels. Majority of the selected preschoolers (15 out of 20) have progressed to be moderate and strong critical thinkers after going through the infusion lessons. Through feedback gathered from the selected teachers, it was also found that the fifteen hours of infusion lessons; provided strong platforms for preschoolers to be actively engaged in thinking practices. The selected preschoolers appeared to learn to 'think critically' as a cumulative process when they are exposed to a series of consistent thinking process which encouraged interpretation and analysis of new information (data) and issues (problems), 'assimilating' these data or problems and 'accommodating' them by restructuring their present mental framework as per suggested by Piaget (Gray, 1997; Robson, 2012; Caruso, 2015). Going through this process of 'thinking' consistently for a period of eight weeks, is believed to have provided sufficient opportunities for selected preschoolers to practice and strengthen their CTS. Through the improvement of CTS levels among selected preschoolers, it clearly indicated that the sample had benefitted much from the ISM implementation.

The findings reflect the different levels of CTS among selected preschoolers before and after the implementation of ISM as per research objective (2) and the descriptions on the improvement of CTS levels among selected preschoolers, answered research question (2).

Fourthly, through the data collected; the researcher had identified six factors which were believed to have contributed to the process of CTS development for the selected preschoolers. It is essential to ensure that the infusion lessons are interesting and stimulating enough to facilitate the readiness of selected preschoolers towards the learning of CTS (Davis-Seaver, 2000). Besides addressing the individual learning propensities, the adoption of the MI approach was also preferred for collaborative learning in this study which stimulated and enhanced critical thinking. The social aspect of scaffolding from peers (collaboration) and from teachers (guidance) have positive influence on CTS development for the selected preschoolers. The conscious efforts by selected teachers to create thinking routines for promoting CTS purposefully helped to strengthen the CTS development among selected preschoolers.

Although Facione (1990) did not propose for the core cognitive skills of critical thinking to be operated in any fixed pattern or steps, but the findings of this study revealed that the selected preschoolers being young 'freshies' in critical thinking cannot be expected to think critically in a natural way like the adult thinkers. Thus, having a thinking routine helped to provide a consistent pattern for the selected preschoolers to practice the cognitive of aspects critical thinking such as interpretation of information, analysis of data, making possible inferences and evaluation of decisions made. This consistent pattern or thinking routine was found to be beneficial in guiding and helping the selected preschoolers develop the skills of critical thinking. In this study, the selected preschoolers were observed to have practiced and applied the critical thinking abilities in a consistent manner or a routine while they were engaged in the process of problem solving.

The findings of this study also indicate that the provision of a thinking climate that challenged young children for critical thinking consistently in the classroom is essential for helping them develop CTS as critical thinking does not happen on its own. In addition, the provision of MI based thinking activities which enabled the interplay of MI strengths among selected preschoolers is believed to have contributed towards the effective development of their cognitive skills for critical thinking. These research results meet research objective (3) as well as answer research question (3).

Fifthly, the three problem-solving tasks which were designed for the selected preschoolers to apply the four core cognitive skills of CTS were contextualized to suit their real-life experiences. The analysis of data showed that it is possible for preschoolers to apply the CTS that they have learnt for solving problems through *interpreting* the nature of tasks, *analyzing* the information provided, making possible *inferences* and choices followed by *evaluating* the choices of the answers before confirming the final solutions. This finding strongly indicates that selected preschoolers were capable of in-depth thinking. The descriptions of the problem-solving tasks and process are meant for meeting the objectives of research objective (4) and answering research question (4).

In summary, the findings of this study do concede that through infusing core cognitive skills in the daily lessons with MI based activities, children learnt to think critically in a 'structured' manner within short time frame. During the problem-solving process, selected preschoolers have systematically interpreted tasks' requirement, analysed information provided to produce possible inferences and evaluate those possibilities before confirming the choice of solutions. This trend of thinking practices indicated the critical thinking ability. Discussion of findings from learning CTS to applying the acquired CTS for solving problems (illustrated in Figure 7.1 below) supported the theoretical framework proposed for this study whereby the learning of CTS was well facilitated through MI instructional approach and supported by the cognitive and social constructivist learning theories as discussed in chapters 5 and 6.

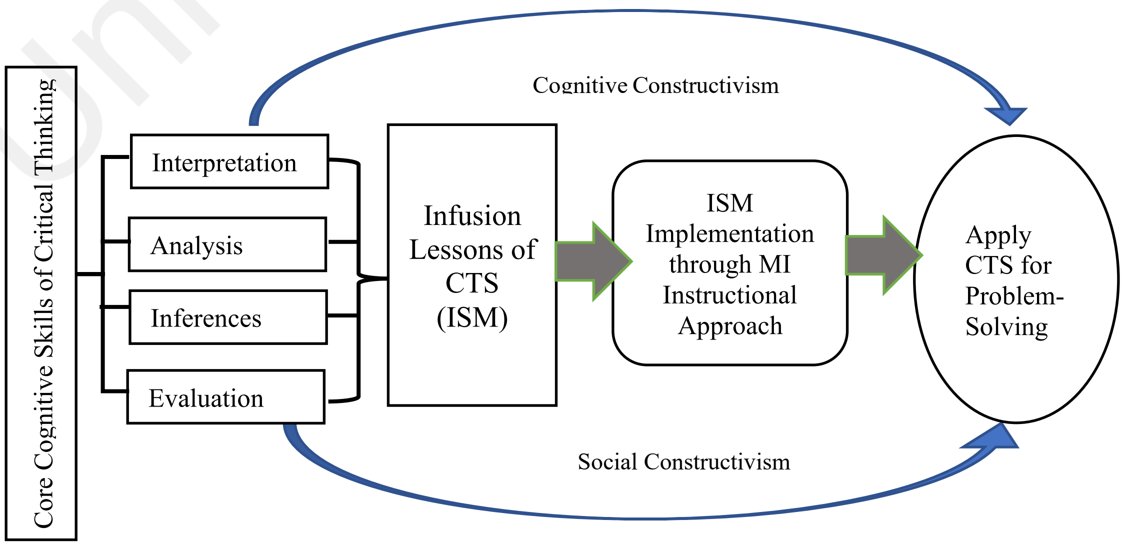


Figure 7.1 Application of CTS for solving problems.

7.3 Implications of the Study

The study on CTS development for preschoolers is essential for the preschool education of the twenty-first century. Although this present study explored the CTS development with only one selected preschool class of twenty preschoolers (six-year-old) at Trinity Kids, however; several implications were identified from the findings with regards to the development of CTS in preschool. Based on the findings of this study, the implications can be put forward in these three aspects: (1) implication for national preschool curriculum of Malaysia, (2) implication for the teaching and development of CTS in preschool and (3) implication for the learning and development of CTS among preschoolers. Each of these implications is discussed in the next few sub-sections.

7.3.1 Implication for the National Preschool Curriculum of Malaysia

Several previous studies (Davis-Seaver, 2000; Lai, 2011; Aubrey et al., 2012; Salmon & Lucas, 2011; Birbili, 2013; Padget, 2014) state that preschoolers as young as the age of four are capable of critical thinking and they should be taught to think critically. The early years educators of Malaysia concurred with the claim that the teaching of CTS should begin during the early years of education. They advocated that CTS teaching should be the primary goal of Malaysia's preschool education (Amalina Munirah Mohd. Zabidi & Nik Suryani Nik Abd. Rahman, 2012; Wong & Yeo, 2014; Zahra, Yusoff & Hasim, 2012). However, among the biggest challenges is that most of the Malaysian preschool teachers would not take the initiative to teach CTS if it is not included as an essential skill officially in the national preschool curriculum. Besides, it can also be too challenging for the preschool teachers to teach CTS without proper guidelines provided.

On the other hand, findings of this study showed that CTS can be integrated or infused into the existing preschool curriculum for CTS to be taught in the classroom across various subjects. The infusion approach for teaching CTS was found to be highly favoured by thinking experts (McGuiness, 1999; Lai, 2011; Padget, 2014; Lin, 2014; Swartz & McGuiness, 2014; Taggart et al., 2005). This implies that CTS can be infused or integrated into all the core subjects of the revised National Preschool Standard-Based Curriculum (NPSC) of Malaysia. The teaching of CTS can be included and to be clearly stated as one of the 'learning standards' for all the core subjects in the NPCS document.

Scholars opined that Early Childhood Education (ECE) practices should infuse the elements of critical thinking skills in the national preschool curriculum as mandatory for teachers (Birbili, 2013; Lin, 2011; Wong & Yeo, 2014). Besides, teachers require explicit guidelines on how to teach in-depth thinking (Bjorklund, 2014). Thus, the inclusion of CTS in the NPCS document would be essential to ensure that CTS is taught explicitly in the preschool classroom.

The CTS inclusion is also meaningful as Malaysia aims to develop critical thinkers from young among the objectives stated in the Malaysia Blueprint of Education 2015. In other words, NPSC should include and mandate CTS teaching as an integral part of the national preschool curriculum guidelines besides focusing on the foundational literacy skills and the various developmental aspects of children.

7.3.2 Implications for the Teaching of CTS in Preschool

Previous studies revealed that most of the preschool teachers are not trained officially to teach CTS and there is no consensus on how to best teach CTS in preschools (Aubrey et al., 2012; Birbili, 2013; Wong & Yeo, 2014). Therefore, many preschool teachers are not confident to promote or teach these skills to young children.

In order for the teaching of CTS to be made explicit in the preschool classrooms, all preschool teachers are required to firstly appreciate what CTS is as well as to acquire the abilities to think critically. Secondly, preschools teachers should be equipped with the skills to teach critical thinking to young children. As such, the teaching of CTS should be included as one of the training modules for the programme standard of ECE (Early Childhood Education) undergraduate courses in colleges or universities (Birbili, 2013). Knowing the strategies and pedagogies to infuse CTS would help ECE teachers teach the skills more effectively to young children.

As infusing CTS in the preschool classroom is a new thing for many preschool teachers, they do need the support of instructional materials to be provided for them. In this study, the instructional support materials (ISM) comprising fifteen hours of lessons with CTS infused into the existing curriculum (across three subjects); was used for teaching CTS explicitly to the selected preschoolers. The selected teachers of this study found the ISM helpful and the selected preschoolers enjoyed learning to think through the MI based thinking activities. In the context of this study, selected preschoolers of Trinity Kids learnt to understand and interpret problems, examine and analyse information provided, reason and suggest inferences as well as to evaluate and confirm decision made. Interpretation, analysis, inference and evaluation are the core cognitive skills of critical thinking.

This study also offers ways for preschool teachers to capitalise on MI based thinking activities and problem-solving tasks to stimulate in-depth or critical thinking skills in the preschool classroom. In this context, the MI based instructional strategy allows selected preschoolers learn critical thinking in ways which are more inclined with their strengths. This is because the MI based strategy offers a wide modality of activities which engage a rich amalgamation of intelligences to help preschoolers learn critical thinking more effectively through various modalities.

For this exploratory case study, a MI diagnostic tool was adapted from Trinity Kids' MI survey. The MI profiling process helped to identify the various strengths of selected preschoolers. The placing of selected preschoolers in the various MI groups further enabled them to work in better collaboration through the interplay of their MI strengths (Armstrong, 2009). The comparison of the CTS assessments (pre and post assessments) indicated that selected preschoolers benefitted from the MI based instruction strategy (Zobisch et al., 2014). This implied that preschool teachers could utilise the MI diagnostic tool to identify and know the strengths of their children in order to facilitate better learning for the children. In this contest, it also further implied that adopting MI as the teaching approach can be considered for effective teaching of CTS as well as enhancing and accelerating the development of CTS among preschoolers. The implication conceded that the interplay and collaboration of MI strengths through working together in MI groups can lead to effective learning and better skill development among preschoolers as per suggested by Gardner's MI Theory.

In addition, important teaching strategies to promote critical thinking such as creating thinking routines, effective questioning techniques and challenging thinking climate are crucial. Like any other skill, learning to think critically or solving problem for the preschoolers requires practice and it takes time to improve or master the skills. In this context, having a thinking routine to guide the selected preschoolers in thinking more critically and to help them apply CTS for solving problems confidently is an advantage (Dowling, 2013; Salmon, 2010; Salmon and Lucas, 2011). In other words, teachers may consider using thinking routines and creating systematic questioning techniques in the classroom to consistently promote critical thinking abilities among preschoolers (Birbili, 2013; Dowling, 2013).

7.3.3 Implications for the Development of CTS in Preschoolers

Although young children may not have engaged critical thinking consciously in their everyday living, but they are potential thinkers undeniably. They are capable of thinking critically whenever they are given the opportunities to be engaged in deliberation of ideas, decision making and problem solving (Birbili, 2013; Davis-Seaver, 2000). Against the belief of some developmentalists, the finding of this study indicated that the cognitive skills required for critical thinking are present in young children and thus, it is essential to develop CTS in them while they are in their early years (Davis-Seaver, 2000; Davis-Seaver & Jane-Davis, 1994).

The implication of the finding of this study further concurred with the constructivist view that the cognitive skills of critical thinking can be taught to foster the CTS development for the young children through allowing them active interactions with the learning environment or engaging actively in solving daily issues and conflicts (Davis-Seaver, 2000; Kibui, 2012). Importantly, teachers must empower the preschoolers to think critically through structuring thinking climates which challenge young children for higher order thinking or critical thinking (Davis-Seaver, 2000; Dowling, 2013; Salmon & Lucas, 2011).

Besides, teachers are to provide support in terms of guidance while constantly creating opportunities of collaboration for young children to think, deliberate and solve problem together in order to scaffold the development of CTS among preschoolers. In the context of this study, this form of scaffolding provided by teachers and peers are strong social support to help selected preschoolers achieve higher proficient level of thinking or critical thinking (Fani & Gaheni, 2011; Smolucha & Smolucha, 1989;

Winsler, 2003). This finding implied that the impact of social support or scaffolding in CTS development of the preschoolers is in alignment with the claim of social constructivism by Vygotsky. Besides, the ability of solving problems is a strong indication that young children are capable of applying the CTS that they have acquired.

Assessing CTS among preschoolers is another new challenge for many ECE educators as there is yet to be a suitable CTS assessment tool available for young children. Thus, the development of PSCTST tools (CTS assessment tool for preschoolers) in this present study can be helpful tools for teachers to assess the CTS levels of preschoolers. In the context of this study, both the pre-assessment or post-assessment tools can be used to compare or gauge the level of CTS in order to determine the degree of improvement or development among young children with the teaching of CTS being implemented. The next section highlights some of the suggestions for future studies.

7.4 Suggestions for Future Studies

In general, the findings of this present case study match the theoretical framework which was proposed in Chapter 3. However, as this study which explores the CTS development of preschoolers covered only one class of six-year-old preschoolers (twenty in total) at one established private preschool centre (Trinity Kids), as such; future exploration may be extended to more preschoolers.

The transferability of the findings in this study would be further enhanced and established when more studies are being conducted involving more preschoolers from other preschools including the public preschools. The findings of these future studies should be able to provide a wider perspective of the CTS development process for preschoolers in Malaysia. Future research would be preferable to cover two or more mai and more classes with a larger number of preschoolers as samples. The samples may even include the five-year-olds to allow an extension of the exploration of CTS development among younger children. Hence, the findings of this study should be subjected to additional and extended research as an enhancement to its reliability.

Furthermore, this present study explored only four out of the six core cognitive skills of APA Delphi Definition such as interpretation, analysis, inference and evaluation. Thus, it calls for further extension into exploring all the six core cognitive skills (interpretation, analysis, inference, evaluation, explanation and self-regulation) for future studies. Besides, as per Delphi's definition, CTS comprised of two main aspects: core-cognitive skills and dispositions. This case study focused only on the core-cognitive aspect. Thus, future studies may also extend to cover the disposition aspect of CTS.

In the aspect of the explicit teaching of CTS through infusion lessons with MI based activities, future studies should include a controlled or comparative group without going through the intervention programme. This is to enable the researcher to examine and ascertain whether the CTS infused lessons with MI based activities have actually contributed to CTS development. Through this, the evidence of the effects or contribution of infusion lessons for CTS development can be ascertain.

Lastly, future studies may consider longitudinal studies to examine the impact of CTS development among young preschoolers if the explicit teaching of CTS begin as early as from five-year-old for the children instead of six-year-old. The evidence of CTS development may be better support by their ability to apply CTS in solving more challenging problems more confidently or independently.

In summary, several other issues related to CTS development of young children can be further explored in future studies. Specifically, this study explored the development of the cognitive skills of critical thinking; future studies can focus on the dispositions; the integral part of critical thinking as well. In the next section, the researcher presents the conclusion of this study.

7.5 Conclusion

The vehicle for teaching CTS explicitly to preschoolers can be varied. What is imperative is that a learning environment which is conducive enough for the development of CTS must be created. In this study, the MI based instructional approach was utilised for teaching CTS in the form of ISM (or infusion lessons) where a conducive learning environment was created for the development of CTS (interpretation, analysis, inferencing and evaluation). As such, other approaches can also be utilised.

However, what is emergent in this study is that once the CTS are developed, the application of these skills is no longer dependent on the teaching approach (in this study, the MI based approach). Rather, the selected preschoolers are able to solve the various thinking tasks (of English, Mathematics and Science) given, based solely on the skills they learnt irrespective of their MI strengths.

In conclusion, the teaching and development of CTS can be approached by preparing an appropriate learning environment using various means or strategies (of which MI is an effective approach as shown in this study). However, the essence of this study shows that preschoolers are able apply the CTS they acquired to solve problems in various contexts regardless of their dominant MI strengths. Thus, the conducive learning environment is essential as the medium in which infusion of CTS can be employed for the explicit teaching of CTS more effectively through an appropriate approach. The MI Approach (MIA) is one of the vehicles that drives and supports the CTS development. Figure 7.2 illustrates the conclusion of this study.

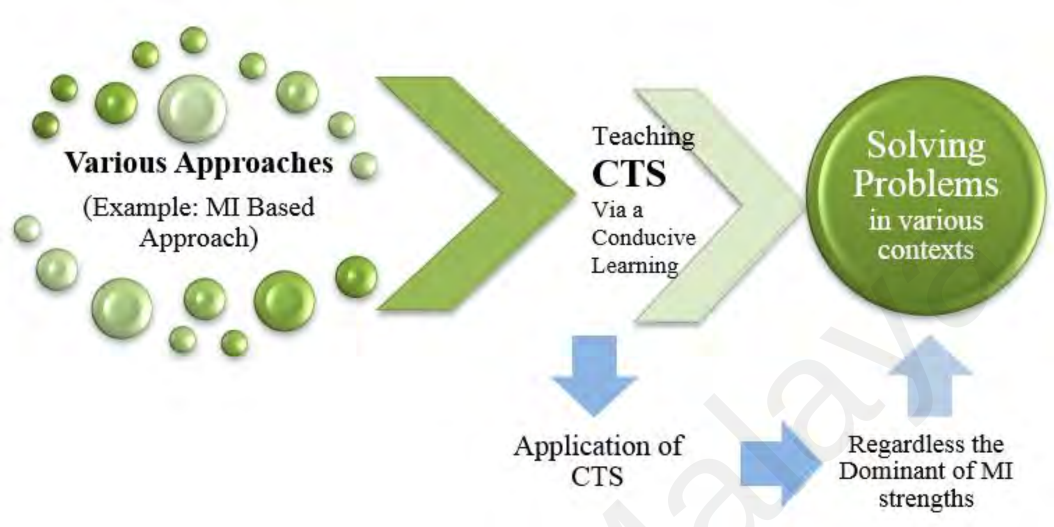


Figure 7.2 Application of CTS acquired for solving problems in various contexts regardless dominant of MI strengths

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