ARGUMENTATIVE KNOWLEDGE CONSTRUCTION PROCESSES IN SOCIAL COLLABORATIVE LEARNING ENVIRONMENT TOWARDS STUDENTS' HIGHER ORDER THINKING SKILLS

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DEDICATION

This thesis is especially dedicated to

my mother ***Jamiah Othman****, my father* ***Ibrahim Yaacob****,*

my husband ***Zairi Ali***

and children

Qaleesya, Qaireena, Qairullah & Qaisara

for their endless love, support, patience and encouragement.

Also, to the memory of

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ABSTRACT

In facing the challenges of the 21st century education, preparing learners towards higher order thinking skills (HOTS) is absolutely essential. To date, many researchers have highlighted the fact that learners are still dearth of HOTs, as dependency on examination-oriented rank and rote memorisation is inadequate to achieve this mission. At present, the implementation of collaborative problem-solving activities in the classroom as student-centred pedagogical practices appears to enhance learning performance effectively. Nevertheless, collaboration does not occur spontaneously, but demands a collaborative learning environment that naturally involves discussion with processes of evidence and argumentation. Argumentation refers to a claim supported by convincing evidence of extensive and comprehensive understanding of numerous aspects pertaining to an issue, in which knowledge is constructed, socially shared among peers, and benefiting individuals. Taking part in online discussions on social collaborative learning environment (SCLE) platform offers opportunities for learners to involve in argumentative debate. However, learners rarely formulate knowledgeable arguments or benefit individually from participating in online discussions. Therefore, the challenge lies in ensuring argumentative knowledge construction (AKC) process in SCLE, which can certainly enhance students' thinking skills in line with HOTS. That being said, this study designed a SCLE using Edmodo to serve as an education tool by adopting the concept of a social network, as well as refining and making it appropriate for the classroom setting, so as to conduct three group discussion sessions for collaborative problem-solving tasks (CPT), with the aim of identifying how and what types of AKC process contribute to students' HOTS. A group of undergraduate students from the Computer Science program had participated in this study (n=21). The mixed method research design, particularly the pre-experimental research design that involved type one group pre-test and post-test design, had been carried out. Data from the students' performance test and CPT discussion in Edmodo group were collected and analysed using content analysis method to identify the AKC process and to evaluate the students' HOTS performance. In order to further comprehend the thinking skills development and the AKC process in light of students' HOTS, the interview technique was incorporated. The results retrieved from Wilcoxon signed rank test revealed statistically significant variance in the level of students' HOTS in performance test (mean= 11.57; Z= -3.42, p= .001<.05). Next, the outcomes from Cohen (d= 0.81) exhibited the significant effect size of SCLE towards student performance in test. The triangulation results from the interview and the students' discussion scripts for CPT highlighted six features of SCLE that contributed to the development of the students' HOTS and AKC, namely: thinking space, stimulate HOTS, common environment, interactive learning, space for knowledge sharing, and instructor as facilitator. As for the AKC process, it was dominated by SOC2 dimension, which refers to questioning the learning partner or provoking a reaction from the learning partner. The study outcomes displayed that the AKC process promoted the students' HOTS in SCLE through constructive interaction, intensive analysis, in-depth thinking, as well as persuasive and reasoning skills. Overall, based on the study findings, a framework of AKC process through SCLE has been developed as a guide to cultivate students' HOTS and AKC process development.

ABSTRAK

Bagi menghadapi cabaran pendidikan abad ke-21, persediaan pelajar ke arah kemahiran berfikir aras tinggi (HOTS) adalah penting. Sehingga kini, kebanyakan penyelidik mendapati bahawa pelajar masih lemah dalam HOTS dan kebergantungan kepada kedudukan dalam peperiksaan dan hafalan semata-mata adalah tidak mencukupi untuk mencapai misi ini. Pada masa ini, pelaksanaan aktiviti penyelesaian masalah secara kolaboratif di dalam kelas sebagai amalan pedagogi berpusatkan pelajar nampaknya dapat meningkatkan prestasi pembelajaran. Namun begitu, bagi memastikan kolaborasi antara pelajar, persekitaran kolaboratif perlulah melibatkan perbincangan yang disertai dengan proses perdebatan dan pembuktian fakta. Perdebatan merujuk kepada suatu pernyataan yang disokong oleh bukti yang meyakinkan dan pemahaman yang luas serta komprehensif mengenai pelbagai isu di mana melaluinya pengetahuan dibina, dikongsikan bersama rakan sebaya dan memberi manfaat kepada individu. Selain itu, menyertai perbincangan dalam talian dalam persekitaran pembelajaran kolaboratif sosial (SCLE) juga akan memberi peluang kepada pelajar untuk terlibat dalam proses perdebatan. Namun begitu, pelajar didapati jarang merumuskan hujah yang membina pengetahuan atau mengambil faedah secara individu melalui perbincangan dalam talian. Oleh itu, cabarannya ialah bagaimana memastikan proses pembinaan pengetahuan secara perdebatan (AKC) dalam SCLE akan meningkatkan kemahiran berfikir pelajar ke arah HOTS. Kajian ini telah merekabentuk SCLE menggunakan Edmodo sebagai alat bantuan pengajaran yang mengambil idea rangkaian sosial dan disesuaikan bagi perlaksanaan tiga tugas menyelesaikan masalah secara kolaboratif (CPT) untuk mengenal pasti bagaimana dan apakah jenis proses AKC yang menyumbang kepada HOTS pelajar. Sampel adalah pelajar sarjana muda dari program Sains Komputer (n=21). Kajian ini juga mengaplikasikan reka bentuk penyelidikan pra-eksperimen secara triangulasi. Data daripada ujian prestasi pelajar dan hasil perbincangan CPT dalam kumpulan Edmodo dikumpulkan dan dianalisis menggunakan kaedah analisis kandungan untuk mendapatkan proses AKC dan prestasi HOTS pelajar. Untuk lebih memahami perkembangan kemahiran berfikir dan proses AKC ke arah HOTS pelajar, instrumen temubual turut digunakan. Hasil daripada ujian *Wilcoxon signed rank* menunjukkan bahawa terdapat perbezaan statistik yang signifikan dalam tahap HOTS pelajar (min = 11.57; Z=-3.42, p=.001<.05). Keputusan Cohen (d = 0.81) juga menunjukkan bahawa saiz kesan SCLE ke arah prestasi pelajar dalam ujian adalah signifikan. Keputusan triangulasi dari skrip temubual dan perbincangan dalam CPT pula mendapati bahawa terdapat enam ciri SCLE yang menyumbang kepada pembangunan HOTS dan AKC pelajar iaitu sebagai ruang berfikir, merangsang HOTS, persekitaran umum, pembelajaran interaktif, ruang untuk perkongsian ilmu dan pengajar sebagai fasilitator. Bagi proses AKC pula ianya didominasi oleh dimensi SOC2 yang melibatkan proses pertanyaan atau memprovokasi reaksi dari rakan. Selain itu didapati bahawa proses AKC dapat menyumbang dalam mempromosikan HOTS pelajar dalam SCLE menerusi interaksi yang konstruktif, analisis secara intensif, pemikiran yang mendalam, kemahiran menyakinkan dan kemahiran penaakulan. Secara keseluruhannya, berdasarkan kesemua dapatan, rangka kerja proses AKC melalui SCLE juga diformulasi sebagai panduan bagi tujuan memupuk pembangunan proses HOTS dan AKC pelajar.

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LIST OF ABBREVIATIONS

ADDIE	-	Analyse, Design, Development, Implementation, Evaluation
AKC	-	Argumentative Knowledge Construction
AR	-	Augmented Reality
ARG	-	Argumentative dimension
C1	-	Knowledge level
C2	-	Comprehension level
C3	-	Application level
C4	-	Analysis level
C5	-	Synthesis level
C6	-	Evaluation level
CASE	-	Configurable Argumentation Support Engine
CPT	-	Collaborative Problem-solving Task
CSCL	-	Computer-supported Collaborative Learning
CSCW	-	Computer-supported Cooperative Working
EPI	-	Epistemic dimension
HEI	-	Higher Education Institutes
HOTS	-	Higher Order Thinking Skills
ICT	-	Information and Communication Technology
IR	-	Industrial Revolution
IOT	-	Internet of Thing
KBKK	-	Critical and Creative Thinking Skills
KBSM	-	Integrated Curriculum for Secondary Schools
LMS	-	Learning Management System
LOTS	-	Lower Order Thinking Skills
MDEC	-	Malaysia Digital Economy Corporation
MOE	-	Ministry of Education
OECD	-	Organization for Economic Co-operation and Development
PAR	-	Participation dimension
PIRLS	-	Progress in International Reading Literacy Study
PISA	-	Programme for International Student Assessment

QA	-	Questioning & Argumentation
RQ	-	Research Question
SCLE	-	Social Collaborative Learning Environment
SD	-	Standard Deviation
SNSs	-	Social Network Services
SOC	-	Social modes of co-construction dimension
STEM	-	Science, Technology, Engineering and Mathematics
TIMSS	-	Trends in International Mathematics and Science Study
UML	-	Unified Modelling Language
WWW	-	World Wide Web
ZPD	-	Zone of Proximal Development

LIST OF SYMBOLS

X	-	An exposure of a group to an experimental variable or treatment event (AKC process in SCLE)
O	-	Process of observation such as performance test
O_1	-	Pre-test assessment
O_2	-	Post-test assessment
d	-	Cohen Kappa effect size
N	-	Total number of rated items
pr_a	-	Proportion of subjects on which the raters agree (percent agreement)
pr_e	-	Proportion of agreement that would be expected by chance (chance agreement)
n	-	Sample size
Z	-	Z score

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Currently, an expectation towards a highly successful upcoming education system is important to accomplish. What kinds of students can best-prepared to meet the challenges of 21st century economy and what kind of education should prepare them for this rapidly globalizing world? In future education, preparing learners for involvement in a networked and information culture is a basic requirement where knowledge is the most critical resource for social and economic development (Saavedra & Opfer, 2012). Students must learn to construct new knowledge to be able to connect to diverse knowledge, and eventually learn a range of important cognitive skills, including problem-solving, reasoning, critical and creative thinking, and innovation (Van Laar *et al*., 2017; Scott, 2015; Voogt & Roblin, 2012). Excitingly enough, today's students are active learners rather than being just as listeners. They view themselves as participants in creating information and new ideas (Leadbeater, 2008). Thus, forming working relationships with teachers and partners in the community and working collaboratively with peers will contribute to productive learning experiences for learners worldwide (Bolstad, 2011; El Helou, 2010). In order to encourage students actively participate in the shared learning, the introduction of technology in education such as peer learning (Chiu & Hew, 2018; Kelly & Katz, 2016), collaborative learning (Veerman & Veldhuis-Diermanse, 2001) and computer-supported collaborative learning (CSCL) (Sung, Yang & Lee, 2017; Jeong & Hmelo-Silver, 2016; Stahl, Koschmann & Suthers, 2006; Islas, 2004; Harasim, 2002; Kanuka & Anderson, 1998) has greatly increased. CSCL refers to a learning situation in which student collaborating, mediated by computers technology and become one of the promising innovations in improving teaching and learning with the help of modern information and communication technology (ICT) (Lehtinen *et al.*, 2000).

In its ideal form, CSCL involves the mutual engagement of learners in a coordinated effort to solve problems and acquire knowledge. Besides, CSCL also promotes meta-cognitive processes, reflective interaction, and problem-solving which can lead to the successful development of learning improvement and learners' knowledge sharing and knowledge construction (Walker, 2005; Jonassen & Kwon, 2001). Concerning with the various applicability of learning in technology, computational thinking alike Computer Programming seems to be a compulsory courses for students for Computer Science, Engineering and Education. With the ICT establishment competencies for 21st century, in recent years the programming concept has moved into secondary and even primary schools. According to Tasneem (2012) and Wang *et al*. (2017), an introductory programming course can foster students' critical thinking, logical reasoning and problem-solving skills which are part of higher order thinking skills (HOTS) and later can apply to their respective disciplines and daily life. HOTS as an individual capacity is necessary yet insufficient for learning. It is suggested that the more the students take ownership of the information, the greater chance they have of retrieving and developing deeper understanding of the information in constructing their knowledge towards high level of cognitive process. Students should be encouraged to become active learners in the collaborative learning environment that engage in the knowledge construction process, discussion and not only memorize data or just agree on what they read or are told without critically thinking about it (Hurst, Wallace & Nixon, 2013; Scriven & Paul, 2008; Templeaar, 2006; Schafersman, 1991). Besides, the purposeful discussion mostly allow students to explore deeper, struggle with the ideas and meanings, idea of investigation, constructing knowledge and problem exploration which also builds group decision making abilities and advances HOTS (Arends, 2004; Wilen, 2004).

According to Baker (2009), along with collaborative discussion, usually occurs situation namely "argumentative interaction". In argumentative interaction, constructing knowledge at a higher level is important for students' learning, because it guarantees students are experiencing meaningful and fruitful learning (Shukor et al., 2014). Though argumentative knowledge construction (AKC) skills seem to be so much necessary, students rarely argue effectively (Bocconi, 2010; Stein & Albro,

2001). Thus, several works in CSCL have considered the argumentation as a matter to assess cognitive consequences, engage and support students in dialogic argumentation which has been seen as excellent opportunities for students to productively propose, support, evaluate, critique, and refine ideas especially in online learning environments (Clark et al., 2007; Weinberger & Fischer, 2006). In online learning environment, the increment usage of social media are ubiquitous to millennium learners and educators see the potential benefits of using these tools for academic purposes (Hughes, 2009; Nellison, 2007) and social network services (SNSs) can be a convenient platform for CSCL. However, it is found that low percentage of students and instructors use them for educational purposes (Chen & Bryer 2012). As well, little is known about how academic opinion change and AKC can be facilitated in SNSs and an existing argumentation practice in informal SNSs discussions typically needs contentious quality (Tsovaltzi et al., 2012). Therefore, it is now well known that argumentative interactions can be vehicles of collaborative learning, especially on CSCL towards fostering student HOTS particularly in learning Computer Programming. In recent years, educational research has attempted to determine under what circumstances collaborative learning is more effective than learning alone, and more recently, numerous studies have focused on computer-mediated collaborative learning. Thus, it becomes the aspiration of the government of Malaysia to develop graduates for the job market who are able to think critically, are innovative and able to solve real world problems, as well as are holistic and well-balanced (MOE, 2015).

1.2 Background of the Study

As science and technology innovations are increasingly important in the global economy market of the 21st century, Malaysia needs to produce students who are capable of generating science and technology innovation to contribute to the well-being of mankind as well as to trigger the country's economic growth. In order to realize the future education system, teaching and learning should become one the most interesting platform to better prepare the student towards that goal. In this subsection, the discussion on facing the challenges towards 21st century learning and

the importance of learning towards HOTS are discussed. Then, the discussion on how to cultivate students' HOTS and its relationship with knowledge construction process in active learning is further elaborated. The strategy in developing knowledge construction in collaborative learning, collaborative problem-solving in Computer Programming and how it later derived to AKC process are also discussed. Afterward, the potential technology used in education such as CSCL is explained on just how it foster students' HOTS and AKC process in SCLE.

1.2.1 Challenges towards 21st Century and the Importance of Higher Order Thinking Skills (HOTS)

In terms of 21st century skills, several studies have reported that Malaysian students' development of 21st century skills is not encouraging across all levels of education from the secondary to the undergraduate level. Teck and Lai (2011) and Ariffin, Nordin and Karim (2008) reported that the level of Form Four and Pre-University students' in ICT skills is low. Additionally, communication and problem-solving skills for undergraduate students also still at the moderate level (Amin, Jaafar, Hood, Saad & Amin, 2013). In fact, from the research been done by Yee *et al*. (2011), none of student perceived their thinking skills' levels are at higher level. The result shows that students' academic result has no effect on the level of thinking skills and students who have good academic achievement does not necessarily have a high level in HOTS compared to students with low academic achievement. Additionally, an overemphasis of the examination system, distractions of administration work and regular change of education policy leads to the failure of implementation of HOTS (Yue-Yi, 2016). Most students are struggling to familiarize to inculcate HOTS integrated syllabus learning especially in completing HOTS based tasks and questions in examinations. Eventually, students find it difficult to develop and generate ideas in response to HOTS type of questions (Heong *et al*., 2010). Thus, it has been said that Malaysian students are lacking the HOTS (Dorothy *et al.,* 2016) although efforts in comprehending them have been in progress for over a decade (Nagappan, 2010). Basically, developing HOTS among students surely takes time

adding to the fact that Malaysian students are used to being spoon fed (Kasim, 2013) and does not put the effort into solving problems.

Therefore, students are advised to actively construct their own knowledge structures learning process (Dolmans *et al*. 2005; Savery and Duffy 1996). Knowledge construction requires students' to activate their prior knowledge and stimulating its processing. In that way, new information is integrated into students' existing knowledge structures, and the numbers of related concepts are growths (Dolmans *et al.* 2005; Schmidt 1993). Indeed, activating prior knowledge and conceptions is important in order to prevent possible misconceptions about a topic and helps students gain various and coherent knowledge structures, which in practice appear as a deeper understanding of a topic and an easier activation of knowledge, particularly towards HOTS. Furthermore, students with HOTS are able to compete better in the challenging world (Cookson, 2009). Therefore, if the goal of teaching is to stimulate understanding, so educators must change their way of teaching from rote memorization of knowledge and facts, to active and constructive processes (Ritchhart *et al*., 2011).

Furthermore, to face the challenges towards 21st century, student not only need to learn HOTS but mastering HOTS particularly at the tertiary educational level is important in order to meet employers' constantly increasing demands for independent and problem-solving employees since companies found difficulty in finding employees who possess these HOTS (Kreitzberg & Kreitzberg, 2009) and the problem of unemployment is a global issue that has become a main concern among countries all over the world (Esa, Suadi & Daud, 2013). Rapid changing and challenging world requires students to go beyond the building of their knowledge capacity which they need to develop their HOTS, such as critical system thinking, decision making, and problem-solving (Barak, Ben-Chaim, & Zoller, 2007). From Organization for Economic Co-operation and Development (OECD) analyses, in the knowledge economy, memorization of facts and procedures is not enough for success. Essentially, educated workers need a conceptual understanding of complex concepts, and the ability to work with them creatively to construct new ideas, new theories, new products, and new knowledge.

1.2.2 Knowledge Construction in Active Learning

New ideas and experiences are matched against existing knowledge, and the learner constructs new or adapted rules to make sense of the world. Researchers and theorists have increasingly recognized that learning is not only a cognitive, but also a social, cultural, and interpersonal, constructive process (Salomon & Perkins, 1998). In active learning, learning process is focusing on construction of new knowledge (Koohang, 2009; Koohang & Harman, 2005; Bonwell, Eison & Bonwell, 2000). Prince (2004) stated that active learning is focusing on student activity and student engagement in the learning process which requires students to utilize HOTS such as analysis, synthesis, and evaluation (Phumeechanya & Wannapiroon, 2014; Bonwell & Eison, 1991). Besides active learning, Lantolf (2004) indicated that construction of knowledge is also a socio-culturally mediated process. The cognitive growth occurs first on a social level, and then it can occur within the individual (Vygotsky, 1978). Meaning that, to make sense of others and construct knowledge on such a social level allow learners to relate themselves to situations. Understanding of social experience and the force of the cognitive process derives from the social interaction and learning can be considered on a continuum from social constructivism to constructivism (Amineh & Asl, 2015).

Mainly, students 'construct' their own meaning by building on their previous knowledge and experience. New ideas and experiences are matched against existing knowledge, and the learner constructs new or adapted rules to make sense of the world. In constructing knowledge, it requires students to think about their thinking and about improving the process, and it requires students to use HOTS and not just memorize data or accept what they read or are told without critically thinking about it (Scriven & Paul, 2008; Schafersman, 1991; Templeaar, 2006). However, finding indicates that the level of knowledge construction is quite low (K. Durairaj & I. N. Umar, 2014; Yee *et al.,* 2011). Hong and Lee (2008) claimed that the students were active in constructing knowledge but narrowing in seeking and giving opinions among peers and knowledge telling. Thus, students need to be able critically to evaluate what they read, able to express them clearly both verbally and in writing, and understand scientific and mathematical thinking. In addition, they need to learn

integrated, usable knowledge, and able to take responsibility for their own continuing, lifelong learning and lifelong learning are primarily collaborative rather than competitive (Sharples, 2000). According to Dillenbourg (1999), the ability to deal with conflicting ideas and knowledge is a central element in collaborative knowledge construction.

1.2.3 Collaborative Learning as Learning Strategy

In collaborative learning, constructing knowledge at higher level is essential for students' learning because it ensures students acquire knowledge through the elaboration of learning material by constructing arguments (Stegmann, Weinberger, Fischer, 2007). Learners are typically supposed to construct knowledge by working on complex problems together, including individually contributing to solving the problem, partaking in discussion of the individual contributions, and arriving at joint solutions (Roschelle & Teasley, 1995). Therefore, when collaborative learning is introduced into class, students need to be trained in group dynamics theory, social skills and conflict resolution. Constructivist theories suggest that learning occurs through discussion with others rather than on an individual basis (Shuell, 2001). It is then assumed that students should be encouraged to become active learners who engage in the knowledge construction process both inside and outside the classroom. Hence, in the collaborative learning environment, the purposeful dialogue will allow students to delve deeper, and to wrestle with the shared ideas and meanings presented in class (Arends, 2004).

Within the collaborative process, learners may adopt ideas from their peers and after collaborating share specific ideas. Hence, collaborative learning is the learning situation in which the learner carries out a learning task in interaction with one or more actors under shared responsibility and with an aim or product shared by all participants. Indeed, it was found that, in collaborative learning environment, students' cognitive engagement can be potentially increased since interaction with peers promotes sharing of ideas resulting in knowledge construction (Veerman & Veldhuis-Diermanse, 2001). Studies also shows that collaborative learning provides

opportunities for sharing information, which in turn will encourage self-reflection on their own learning (Mukama, 2010) and students' critical thinking skills were shown significantly when it is done socially and collaboratively amongst peers (Noroozi *et al*., 2012; Chou & Chen, 2008; Veerman *et al*., 2002; Dillenbourg, 1999; Gokhale, 1995).

Unfortunately, students' typical uncooperative and refusing attitude (Maloney & Simon, 2006) combined with their lack of engagement with one another's ideas (Brown & Campione, 1996; Hatano & Inagaki, 1991) lead to their dearth of success in working collaboratively and learning. Although this process helps students increasing their thinking skills and encourages them to construct new knowledge but, they often hate the fact that group work shifts the burden of learning to them, for examples some members tend be 'asleep' or excluded from interactions, and which encourage lurking (D'souza & Wood, 2003; Heilesen *et al*., 2002; Veldhuis-Diermanse, 2002; Dillenbourg & Schneider, 1995). For that reason, they preferred hearing the teacher presents the important facts without having crucially thinking in reforming any new knowledge or ideas. For instance, there are some group just simply sit back and let the other members of the group do all the work or a "free rider" or "sleeping partner" effect (Salomon & Globerson, 1989) and sometimes turns into a "sucker effect" when the group members who are doing all the work start to contribute less to group work to avoid being a sucker (Webb & Palincsar, 1996). Meloth and Deering (1999) also found violence and hostility to lead will results to unconstructive arguments, passivity, acquiescence and premature agreement on answers. Another issue that may arise in group setting is students' failure to seek help from peers when it is needed. For instances, students may simply not be aware of the fact that they need help and even if they are, be hesitant to seek such help for fear of being judged incompetent or unwanted member of the team (Webb & Mastergeorge, 2003; Nelson-Le Gall *et al.*, 1983).

Thus, one of the suggestions is the introduction of 'computational thinking' into the national curricula (Zainudin, 2016). Wing (2006) pitched the idea as the skill that students need to grasp to prepare them in the 21st century and become a set of skills that can be applied to everyone, not specifically to be used only by computer

scientists. Generally, Wing (2006) has defined computational thinking skills as a way of solving problems, designing systems and understanding human behavior by drawing the concepts of computer science. In another term, computational thinking skills can be explained as an alternative method in generating solution through mental blocks in the students' mind. However, the integration into the curricula is said to be difficult (Ling *et al*., 2016) although the concepts have been used unknowingly in their practice. Computational thinking is associated as an approach to develop problem-solving skills (Zainudin, 2016) and has been suggested to be added in the 'C' list of the 21st century skills: Critical Thinking, Creativity, Collaboration and Communication skills that are identified as the necessary skills in the school curricula (Grover, 2018).

In the recent years, there has been renewed interest in introducing programming (Grover & Pea, 2013; Kafai & Burke, 2013). During programming, students are exposed to computational thinking. It involves the use of computer science concepts such as abstraction, debugging, remixing and iteration to solve problems (Brennan & Resnick, 2012; Ioannidou, Bennett, Repenning, Koh, & Basawapatna, 2011; Wing, 2008). This form of thinking can be considered to be fundamental for students because it requires "thinking at multiple abstractions" (Wing, 2006). More importantly, computational thinking is in line with many aspects of 21st century competencies such as creativity, critical thinking, and problem-solving (Binkley *et al*., 2012; Ananiadou & Claro, 2009). Thus, it is not surprising that many educators assert that programming is important for students in this era (Kafai & Burke, 2013; Resnick *et al*., 2009). This revived interest in programming suggests the need to consider how it can be better related to the kinds of educational outcomes that it can potentially foster. Some of the outcomes suggested by researchers are the ability to think more systematically (Kafai & Burke, 2013) and the development of mathematical and scientific expertise (Sengupta, Kinnebrew, Basu, Biswas, & Clark, 2013). However, there is a dearth of research that explores computational thinking through programming (Grover & Pea, 2013) specifically through collaborative learning.

Still, the benefits of collaborative learning are becoming increasingly recognized by educators in computing (Furberg, Kluge & Ludvigsen, 2013; Maguire & Maguire, 2013; Kaye, 2012; Hwang, Shadiev, Huang, 2011; Tsai, Li, Elston & Chen, 2011; Yoon, 2011; O'Donnell, Hmelo-Silver, & Erkens, 2005). For example, Schäfer *et al*. (2013) found that mathematical logic skills were enhanced when students worked together in collaborative games, while Tsai *et al*. (2011) found collaborative learning enhanced student experience in producing Wiki websites. Maguire and Maguire (2013) found that working in teams to answer clicker questions had positive effects on student engagement and performance within computer science lectures. Williams and Upchurch (2001) observed that students working collaboratively found the experience more enjoyable than working alone and repeatedly cited how much they had learned from each other and concurrently team communication and effectiveness also improved. Nagappan *et al*. (2003) found that students and demonstrators reported labs to be more productive, less frustrating and more conducive to advanced, active learning than traditional labs. A systematic review by Salleh *et al*. (2011) also concluded that pair programming consistently leads to improved grades and increased student satisfaction, where students work in pairs, encouraging and correcting each other.

Bachu and Bernard (2012) stated that CSCL can increase the benefits of collaboration by enhancing the metacognitive abilities of students in the problem solving stage of programming. Their study develops a framework for the development of a CSCL environment which incorporates a number of characteristics such as promotes: (1) *positive interdependence* where each member of the group becomes personally responsible for the group's success, (2) *argumentative discussion* where each member of the group must be aware of the need to make the best decision and encouraged to discuss and defend their reasoning for a given action, (3) *equal participation* where all members of the collaborative group take full responsibility for their learning and learn through the experiences of the other members of the group. Such systems aim directly at enhancing the metacognitive skill of students so that they know what they know and know how and when to apply basic concepts in a constructive manner to produce an algorithm that is the solution

to a problem. From their study, an assumption towards developing a framework in this study can be relating.

1.2.4 Computer-supported Collaborative Learning (CSCL) as Potential Learning Environment

It is important to have a learning environment that makes effective use of ICT's distinctive features in order to foster the abilities required for children living amid the drastic changes of the 21st century. CSCL is an emerging branch of the learning sciences concerned with studying how people can learn together with the help of computers (Stahl, 2006). Computers have become important in this, with school districts and politicians around the world setting goals of increasing student access to computers and the Internet. The idea of encouraging students to learn together in small groups has also become increasingly emphasized in the broader learning sciences. However, the ability to combine these two ideas (computer support and collaborative learning, or technology and education) to effectively enhance learning remains a challenge that CSCL is designed to address (Stahl, 2008).

Over the last decade, a number of sophisticated environments have been developed in order to support students engaging in this type of knowledge-building discourse and CSCL is one of the most promising innovations to improve teaching and learning with the help of modern ICT (Lehtinen *et al*, 1999). The main focus of CSCL is on the use of computer technology to enhance peer interaction and learning (Lipponen *et al.*, 2003). In its ideal form, CSCL involves the mutual engagement of learners in a coordinated effort to solve problems and acquire knowledge. In order to accomplish learning gains, the interaction among students has been studied by the CSCL community, an important means of implementing constructivist and sociocultural educational approaches.

While CSCL and the use of networked technology has been a very popular trend in research and design of learning environments, empirical research has shown that there is no guarantee that networked collaboration leads to higher level

understanding, and that all individuals of the community equally engaged in new knowledge construction (Strijbos *et. a*l, 2004; De Corte *et. al*, 2003; Leinonen *et. al*, 2003; Jarvela & Hakkinen, 2002). Besides, the establishment and maintenance of active collaboration in online study groups is a challenging task, primarily due to students' inability and often reluctant to participate actively. It is also found that many students did not have a chance to experience collaborative work during their previous education and tend to perceive their colleagues as rivals (Sanders, 2008). The observed difficulties of online group work are often a consequence of sub-optimal group formation. In fact, the creation of an optimal study group is a challenging task.

Therefore, to form any group activities that effective for learning, the situation that engage students in explicitly analysing, value the ideas and respond to claims and evidence of one another's ideas are need to be designed. Usually, in discussions students tend to have "one-way" interactions which hinder collaborative construction of meaning (Weasenforth, Biesenbach-Lucas & Meloni, 2002) and "two-way" interactions deal with surface-level knowledge instead of deeper explanations of the phenomena under study (Cobos & Pifarré, 2008). From Hew and Cheung (2003) study, most of the surface level thinking was due to students making conclusions or judgments without offering any justification; proposing solutions with little details or explanations; and stating that one shares the conclusions or judgments made by others without taking these further. Hence, students need to be taught about the benefits of communicate effectively and one possible way to start is by making the goals of discussion that concerning argumentation more explicit (Rojas-Drummond & Mercer, 2003) and emphasize more activities that promote argumentation (Kuhn, 2010; Nussbaum, 2005; Anderson *et al*., 2001). Students need to learn to argue effectively to be able to participate in collaborative environment, reflect, reason, share, improve understanding of topics, and hence develop critical thinking ideas for constructing knowledge (Ravenscroft & McAlister, 2008) and eventually cultivate HOTS.

1.2.5 Argumentative Knowledge Construction (AKC)

Collaborative argumentation can be described as engaging learners in a group in dialogical argumentation, critical thinking, elaboration, and reasoning so that they can build up a shared understanding of the issue at stake instead of merely convincing or changing their own and each other's beliefs (Baker, 2009). Constructing knowledge in argumentation is different from a "debate-type, win–lose situation", as in law (Pinkwart, Aleven, Ashley, & Lynch, 2007, 2006). This kind of argumentation is perceived as a means to compete and/or convince others (Asterhan & Schwarz, 2009; Andriessen, 2006), which argumentation serving persuasion or eristic argumentation ("fighting"). Inversely, argumentative knowledge construction (AKC) is defined as the situation where learning partners shared contributions of reasons and evidence from different viewpoints with the goal of learning (Baker, 2009; Ravenscroft & McAlister, 2008). Theoretically, in AKC, learners are build arguments and support a position, to consider and weigh arguments and counterarguments, to test, enlighten, and clarify their uncertainties, to elaborate on the learning materials, and thus acquire knowledge and achieve understanding about complex ill-structured problems during collaborative argumentation (Aleixandre-Jimenez, 2007; Cho & Jonassen, 2002).

Jonassen and Kim (2010) stated that meaning learning requires a deep both compromise and involvement with ideas and knowledge and this deep involvement are grounded in this sub-ability of critical thinking known as argumentation. Besides, learning to argument represents a very important way to think which eases other fundamental, complex and also desired educational goals as are conceptual change and problem-solving abilities. The ability to argue is one of the highest forms of expression of the HOTS and reasoning. Jonassen and Kim (2010) reviewed the literature on the ways and modes how argument capacity impacts to other cognitive abilities and ways of obtaining knowledge. They found that argumentation is related to the most finished kind of thinking, or HOTS which is related to scientific thinking (Siegal, 1995). Generally, practicing scientists involve in argumentation to refine and articulate their own scientific knowledge (Aufschaiter *et al*., 2008). In this study, the learning of Computer Programming which is related to scientific thinking is

importance for AKC as to see how the process can guides the thinking towards HOTS. Moreover, the argument in the AKC process apparently associated with a social constructivist view of meaning construction and involves learning epistemological levels in more mature and deep, where students learn through keeping reflective interactions (arguments) that involve the social construction of knowledge (Driver *et al*., 2000; Newton *et al*., 1999). In arguing about the basis on which claims are based, students by the way investigate the epistemological foundations of knowledge domains.

Although argumentation skills have been clearly identified, the students' ability to generate and/ or evaluate arguments is still unclear. Most researchers have argued that older students are not trained in the ability to argue. For example, Reznitskya *et al*. (2001) showed that most young students do not understand the argumentative discourse, but also experience difficulty in writing persuasive essays, comprehend written arguments, the difference between theory and evidence, generating genuine evidence, alternative theories, counter-arguments or rebuttals (Means and Voss, 1996; Kuhn, 1991). It is unlikely that adolescents and young adults build arguments of both sides (pro and con), or distinguish the evidence of the explanation in support of a statement or conclusion (Kuhn *et al*., 1997; Kuhn, 1991; Voss & Means, 1991). Felton and Kuhn (2001) and Kuhn (1991) agreed that providing supporting evidence for the claims or conclusion is an important criterion for constructing arguments. However, the disputants often use insufficient or inconclusive evidence to support their arguments (Walton, 1996). However, to what extent that the analysis of AKC processes in collaborative learning dialogues brings actual challenges because of the complexity in dealing with multiple perspectives of assessing the students' HOTS? Hence, several works in CSCL have considered the argumentation as a matter to assess cognitive consequences, engage and support students in dialogic argumentation which has been seen as excellent opportunities for students to productively propose, support, evaluate, critique, and refine ideas especially in online learning environments (Clark *et al*., 2007).

It seems that there is a close correlation between learning as a social process and the perception of learning as the construction of knowledge in the AKC process.

In CSCL, the emphasis shifts to interactive learning through cooperation and collaboration among all participants in the process. In the online environment, text has greater significance than in the traditional classroom, since the text typed online exists simultaneously with and contributes to the collaboration between the members of the group. This is a significant extension of the learning and discussion framework as well as of the social context and enrichment of the knowledge construction process that benefits all those involved (Little *et al.*, 2009; Weinberger & Fischer, 2006). Researchers claim that CSCL is an excellent medium for activities involving debate, reflection, and better learning (Williams, Duray, & Venkateshwar, 2006). Web-based communications, especially in the Web 2.0 era, contribute to the advancement of collaborative learning since they encourage pro-activism among users to create social ties, share human experiences, and generate new knowledge for rapid distribution and cooperation (Herwing, Mathias, Strohmaier, Dosinger & Tochtermann, 2007). The interaction between the participants in an online environment also creates an important sense of belonging (Rovai, 2002).

1.2.6 Social Collaborative Learning Environment (SCLE)

Social collaborative learning environment (SCLE) is a place where students, groups and professionals join together. This environment enables them to co-create content, share knowledge, experiences, provide latest information, interacting with one another and to learn collaboratively. To date, learning platform that is facilitated by the internet and World Wide Web (WWW) technology in order to support teaching and learning activities among instructors and learners in virtual environment is known as e-learning. E-learning is defined as an environment in which the learner's interactions with the e-learning material, peers, and instructor via advanced information technologies (Alavi & Leidner, 2001). Recently, the adoption of learning management system (LMS) into e-learning practices in higher education is increased as well as the effectiveness of the university's teaching and learning activities (Ariffin *et al*., 2014). Currently, most of the educational institutions especially higher education institutes (HEI) is adopting Learning Management Systems (LMS), such as Moodle and Sakai (open sources), Blackboard (commercial sources), in order to

centralize content, learning, and assessment activities as one-stop-centre learning environment (Alario-Hoyos *et al*., 2013; Coates, James & Baldwin, 2005). Generally, LMS provide educators and students with a facility to improve and manage both teaching and learning processes. In LMS, a web platform is also provided, to ease the implementation of pedagogical activities with LMS features, such as discussion boards or forums, to facilitate communication and collaborative work.

Furthermore, social networking site (SNS) like Facebook is also being used as LMS in facilitating teaching and learning practices among people in schools and universities (Wang *et al*., 2012). Million users from many countries have used SNS websites like Facebook, Tweeter, LinkedIn, etc. as their social and interaction channel as well as for pedagogy purposes (Akbar, Purwarianti & Zubir, 2013). Due to this phenomenon, a new approach has been developed by combining the social network features into e-learning system which is known as social learning network (SLN) (Halimi, Seridi & Faron-Zucker, 2011) such as Moodle, BlackBoard, Edmodo and Schoology, which are provided for free or with fee. The change of e-learning environment has been influenced by the growth of Web 2.0 technology which provides variety of platforms for communicating, collaborating, sharing and managing knowledge among people. The integration of collaborative learning and social media has become people's preference in providing a good communication platform that can support sharing and learning environment effortlessly (Lim & Finkelstein, 2011). Thus, the adaptation of Web 2.0 applications like social networks, blogs, forum, wikis, etc. in e-learning application has enhanced the social interaction, knowledge sharing and learning practices among people.

However, there is limited research on how social media impacts students and, in particular, how it influences students' learning experience (Hew, 2011; Mix, 2010). From the study of Hew (2011), one of the common themes in previous research is that students use social media for personal reasons, but rarely for educational or learning purposes. Also, the communication features of LMS are poorly utilized in most institutions, and are primarily being used for course content features, such as lecture notes and presentation slides. Marijana, Aleksandra and

Aleksandar (2011) have reported that the frequency of using the LMS provided by the educational institution is very low and has become unpopular among educators. Since the design of existing social and collaborative platform is not aligned with learning environment, thus it has difficulties in adopting the learning course based on social collaborative environment. Therefore, there is a need to propose the appropriate SCLE components that suitable with learning environment in order to facilitate learning activities in a social collaborative way.

1.3 Problem Statement

Studies found that Malaysian students' development of 21st century skills is not encouraging across all levels of education from the secondary to the undergraduate level (Teck & Lai, 2011; Ariffin, Nordin & Karim, 2008). For instances, communication and problem-solving skills for undergraduate students still at the moderate level (Amin, Jaafar, Hood, Saad & Amin, 2013) and none of student perceived their thinking skills' levels are at higher level (Yee *et al*., 2011). Thus, collaborative learning strategy is suggested as a way to improve the knowledge towards HOTS. Unfortunately, students' typical uncooperative and refusing attitude (Maloney & Simon, 2006) combined with their lack of engagement with one another's ideas (Brown & Campione, 1996; Hatano & Inagaki, 1991) lead to their dearth of success in working collaboratively and learning. Lehtinen *et al*. (1999) highlighted that CSCL is one of the most promising innovations to improve teaching and learning with the help of modern ICT. Joining online discussions will provide opportunities for learners to engage in argumentative debate, but learners rarely formulate knowledgeable arguments or benefit individually from participating in online discussions (Stein & Albro, 2001; Kuhn, 1991). However, Hew and Cheung (2003) stated that most of the surface level thinking was due to students making conclusions or judgments without offering any justification; proposing solutions with little details or explanations; and stating that one shares the conclusions or judgments made by others without taking these further. Hence, students need to be taught about the benefits of communicate effectively and one possible way to start is by making the goals of discussion that concerning argumentation more explicit (Rojas-

Drummond & Mercer, 2003) and emphasize more activities that promote argumentation (Kuhn, 2010; Nussbaum, 2005; Anderson *et al*., 2001). In order to nurture student thinking skills to the higher level, an important part of HOTS is to identify, construct, and evaluate arguments and it is believed that student learn well when they actively construct their own understanding through social interaction with their peers (Sthapornnanon *et al*., 2009). Students need to learn to argue effectively to be able to participate in collaborative environment, reflect, reason, share, improve understanding of topics, and hence develop critical thinking ideas for constructing knowledge (Ravenscroft & McAlister, 2008) and eventually cultivate HOTS. Therefore, there is a need to propose appropriate SCLE components that suitable with learning environment in order to facilitate learning activities, particularly emphasizes AKC towards HOTS in a social collaborative way. In this study, Computer Programming subject is focused which is believed that it can inculcate students' critical thinking, logical reasoning and problem-solving skills in which they can later apply to their particular disciplines and their daily life. Thus, the purpose of this research is to first, analyse students' levels of HOTS in Computer Programming subject. Next, after the development of SCLE, this research investigated the influence of SCLE on students' HOTS with the implementation of AKC process. It is important to know just how AKC process in SCLE will contributes towards students' HOTS. Finally, a framework of AKC process in SCLE towards students' HOTS is formulated.

1.4 Research Objectives

The objectives of this study are as follows:

1. To design and develop a social collaborative learning environment using Web 2.0 technologies to support social collaborative learning in learning Computer Programming subject.

2. To describe the impact of learning Computer Programming subject in SCLE on students:

(a) higher order thinking skills,

(b) argumentative knowledge construction.

3. To describe how learning Computer Programming subject through social collaborative learning environment influence students':

   (a) higher order thinking skills,
   (b) argumentative knowledge construction.

4. To analyse types of process involved in students' argumentative knowledge construction in learning Computer Programming subject through social collaborative learning environment.

5. To describe how argumentative knowledge construction in learning Computer Programming subject through social collaborative learning environment contribute towards students' higher order thinking skills.

6. To formulate argumentative knowledge construction framework in learning Computer Programming subject through social collaborative learning environment that cultivate students':

   (a) higher order thinking skills,
   (b) argumentative knowledge construction.

1.5 Research Questions

This study focuses on the following questions:

1. What are the impacts of learning Computer Programming subject in social collaborative learning environment on students:

   (a) higher order thinking skills?
   (b) argumentative knowledge construction?

2. How does learning Computer Programming subject through social collaborative learning environment influence students':

(a) higher order thinking skills?

(b) argumentative knowledge construction?

3. What are the types of process involved in students' argumentative knowledge construction in learning Computer Programming subject through social collaborative learning environment?

4. How does argumentative knowledge construction in learning Computer Programming subject through social collaborative learning environment contribute towards students' higher order thinking skills?

5. What does argumentative knowledge construction framework in learning Computer Programming subject through social collaborative learning environment look like and its relationship with students:

   (a) higher order thinking skills?

   (b) argumentative knowledge construction?

1.6 Theoretical Framework

Theoretical framework outlined the basis of theories that researcher used throughout the study. In this study, the researcher applying several concepts that represented as the standard that contributed to the development of AKC framework in SCLE towards students' HOTS.

1.6.1 Higher Order Thinking Skills (HOTS)

Before developing SCLE, researchers need to first analyze students' cognitive level. The finding on students' level of thinking is important which it can be guidance for researcher during the implementation process later. Students' levels of thinking in AKC process are analyzed based on Bloom taxonomy (1956). In Bloom taxonomy, there are three main categories involves which are cognitive, affective and

psychomotor. However, in this study, we are focusing more into cognitive skills mostly on higher cognitive skills or HOTS (see Figure 1.1). HOTS consist of three upper level of Bloom taxonomy which is *analysis, synthesis* and *evaluation* (Moore & Stanley, 2010).

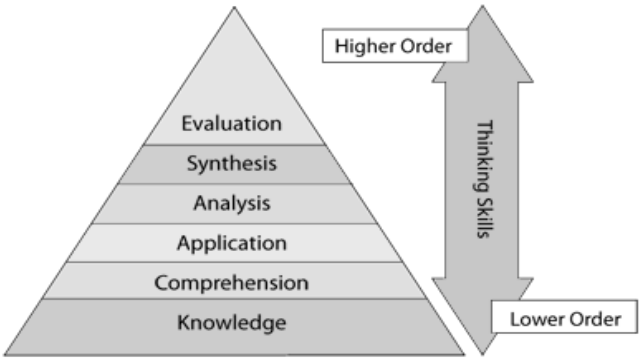

Figure 1.1 Thinking skills in Bloom taxonomy (1956)

1.6.2 Argumentative Knowledge Construction (AKC)

To investigate the quality of students' thinking in AKC process, students' posting or comments in SCLE are collected and evaluated. A specific coding scheme by Weinberger and Fischer (2006) is adopted to code the argumentative messages. In order to see the process of AKC in CSCL, Weinberger and Fischer (2006) suggested that students should engage in four independent dimensions of collaborative learning namely participation, epistemic, argumentative and socio-modes of co-construction:

1. *Participation dimension*: if and how much learners participate;

2. *Epistemic dimension*: on-task versus off-task discourse, and the adequacy of specific epistemic activities to solve a task;

3. *Argument dimension*: construction and balance of sequences of arguments and counterarguments towards a joint solution;

4. *Social modes of co-construction dimension*: to what extent learners refer to and deal with contributions of their peers.

1.6.3 Social Constructivism and CSCL Design Principles

In social constructivism, Vygotsky (1978) states that cognitive growth initially occurs on a social level, and then it can occur within the individual. Meaning that, to make sense of others and construct knowledge on such a social level allow learners to relate themselves to circumstances. In this study, the combination of principle in collaborative learning and social constructivism through CSCL from Lockhorst (2004) incorporated with collaborative learning elements by Johnson and Johnson (1994) is implemented.

1.6.4 ADDIE Model

In this study, the process of each tasks and SCLE are developed based on ADDIE instructional design model. Basically, ADDIE Model is an iterative instructional design process, where the results of the formative evaluation of each phase may lead the instructional designer back to any previous phase. The end product of one phase is the starting product of the next phase (McGriff, 2000). Basically, ADDIE instructional model has five main elements, *analysis, design, development, implementation* and *evaluation*. The details use of ADDIE model in this study is further elaborated in Chapter 4 and Figure 1.2 and Figure 1.3 shows the theoretical framework and its descriptions of the study.

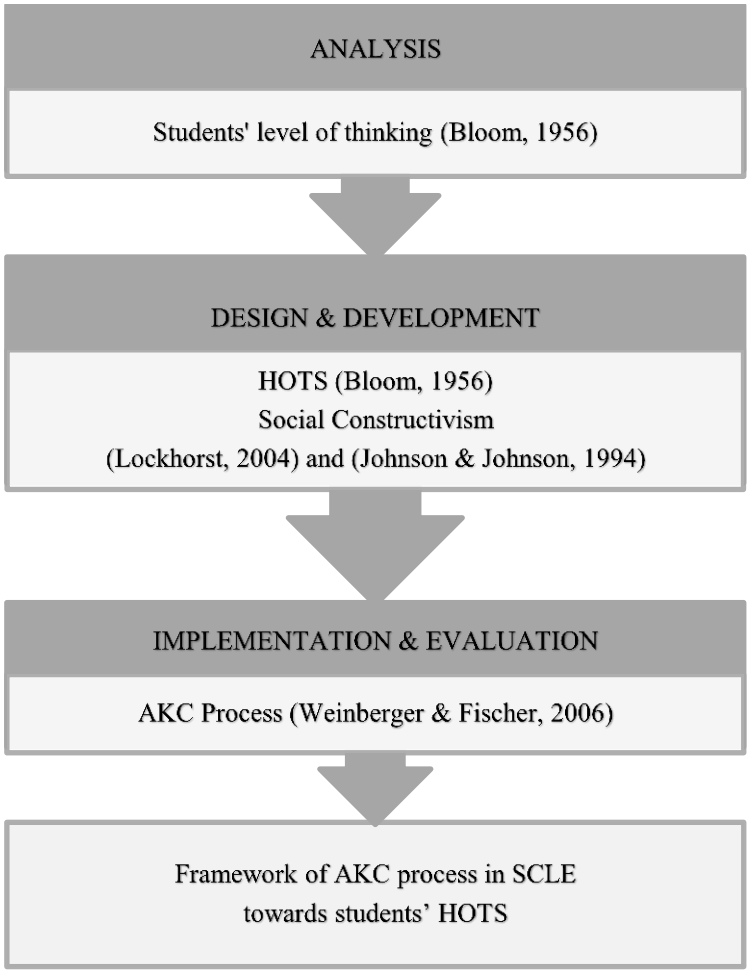

Figure 1.2 Theoretical frameworks

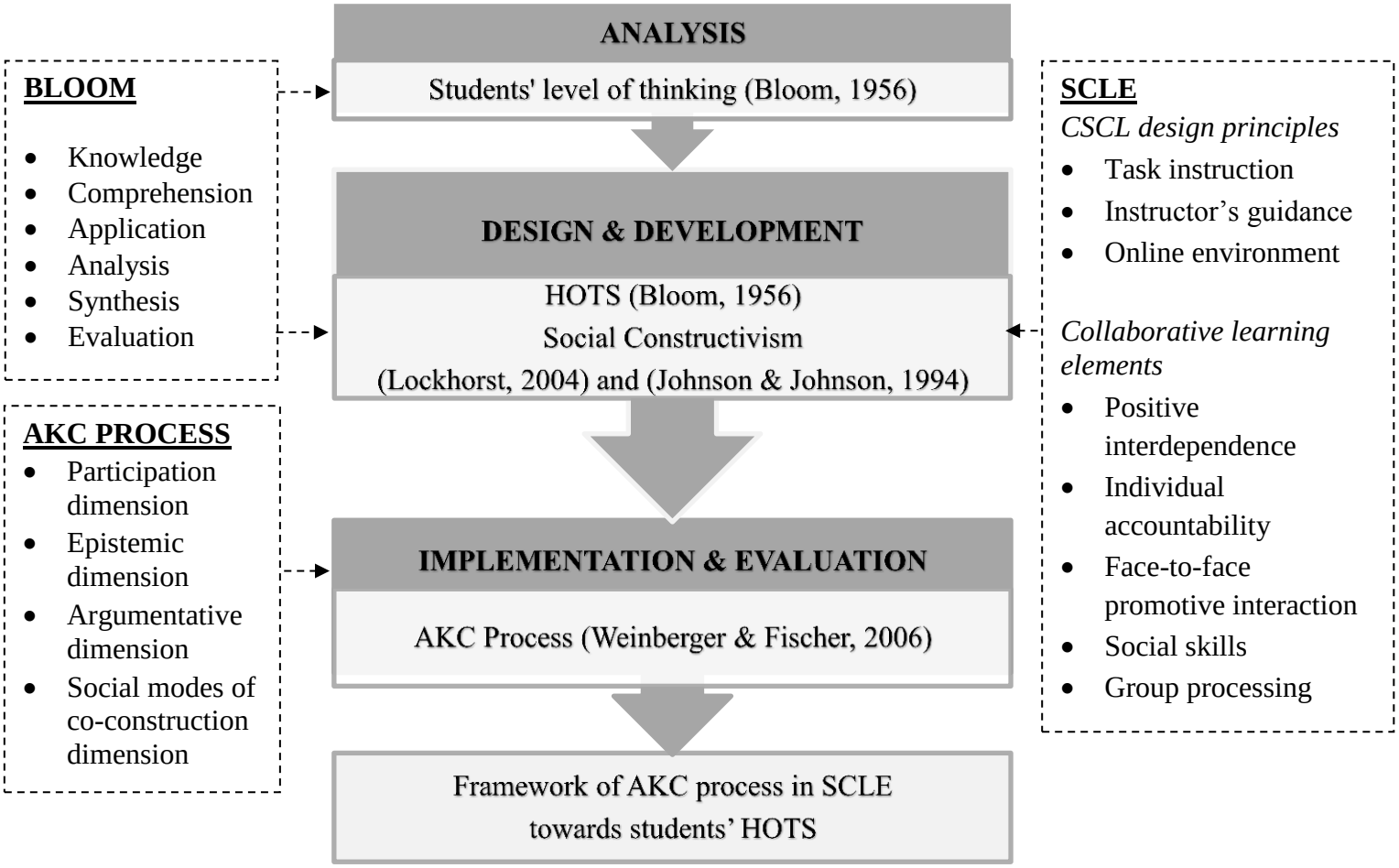

Figure 1.3 Theoretical framework and its descriptions

1.7 Research Rationale

In higher education, developing students' HOTS is a challenging task, as well as to prepare students to be learners, workers, and contributors to society. Current research suggests that AKC is an important component of critical thinking, decision-making, understanding and participating in scientific discourse in everyday situations (Sandoval & Millwood, 2005; Driver, Newton, & Osborne, 2000; Kuhn, 1991). At the same time, this study suggests that AKC can promote individual knowledge construction. For example, students can be stimulated to provide support or counter arguments for their claims and help them elaborate the tasks, gain argumentative knowledge, understand multiple perspectives, and also promote knowledge convergence (Weinberger *et al*., 2010).

1.8 Relevance of Research

The importance of HOTS and AKC process would assist the students in making decision and improve their own futures for their benefit individually and society as a whole. Also, being at low-level, students can advance self-intervention to enhance their learning performance. Likewise, students at the higher-level will be encouraged to maintain their current performance. In addition, this research also intentionally to encourage students to be more independent in arguing and constructing new knowledge or information.

1.9 Scope, Limitation and Delimitation of Research

The research focuses on students' HOTS and AKC process in SCLE, specifically through online discussions under the influence of SCLE. Thinking level in this research's perspective is revealed from students' AKC process in online discussion and construction of knowledge in discussion messages of the given tasks. Samples involved in present research are Malaysian undergraduate students who have basic computer skills and familiar with SCLE and also learned Computer

Programming subject. Simply said, they are computer literate, and thus, skills for learning online are not discusses but rather their level of thinking skills and AKC process while completing the given collaborative problem-solving tasks (CPT). Limitations containing their differences in basic computer skills, as well as gender factors and ages are not being considered in this research. Additionally, the delimitation such as equal performance in students' pre and post-performance test also not further deliberated as the focus is only on the process of AKC in SCLE towards HOTS which concentrate on students with highest differences score in the performance test and active participation in online discussion.

1.10 Operational Definitions

There are several key terms that have been repeatedly used in this study. Below are descriptions of how different terminologies are used in this research:

1.10.1 Higher Order Thinking Skills (HOTS)

Using the Bloom taxonomy (1956), HOTS consists of three upper level which is *analysis*, *synthesis* and *evaluation* (Moore & Stanley, 2010). This taxonomy is important in this research to see students' achievement in performance test and to see how AKC process in SCLE can promote students' cognitive skills towards HOTS.

1. *Analysis*: Breaking material or concepts into parts, determining how the parts relate or interrelate to one another or to an overall structure or purpose.

2. *Synthesis*: Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

3. *Evaluation*: Making judgments based on criteria and standards through checking and critiquing.

1.10.2 Constructivism

In constructivism, learning is represented as a constructive process in which the learner is building an internal illustration of knowledge, a personal interpretation of experience. This representation is always open to modification, its structure and linkages forming the ground to which other knowledge structures are attached. Learning is then an active process in which experience has an important role in understanding and grasping the meaning. Mvududu and Thiel-Burgess (2012) state that constructivism is widely touted as an approach to probe for children's level of understanding and to show that that understanding can increase and change to higher level thinking. Thus, constructivism refers to how of learning and thinking.

1.10.3 Social Constructivism

Social constructivism is a theory of knowledge in sociology and communication theory that examines the knowledge and understandings of the world that are developed jointly by individuals. Vygotsky (1978) believes that learning is a continual movement from the current intellectual level to a higher level which more closely approximates the learner's potential. This movement occurs in the zone of proximal development (ZPD) as a result of social interaction. The zone of proximal development (ZPD) has been defined as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers".

1.10.4 Argumentative Knowledge Construction (AKC)

Mainly, the study focuses on the AKC dimension of CSCL, whereby individual learners in an online environment construct opinions and exchange them in argumentation sequences to resolve different standpoints on the issue at stake and to find well-elaborated solutions for complex problems (Stegmann *et al*., 2012, 2007; Walton & Krabbe, 1995). In this study, AKC process in SCLE is analysed using multi-dimensional approach, from a segmentation of students' online discussion to the analysis of four dimensions of AKC process adapted from Weinberger and Fischer (2006) which is *participation, epistemic, argumentative and social modes of co-construction dimension.*

1.10.5 Collaborative Learning

Collaborative learning represents a significant shift away from the typical teacher-centered environment in classrooms. Usually, students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. In this study, two or more students have to negotiate and reach an agreement about different matters. For example the task, the goals and used concepts and definitions.

1.10.6 Computer-supported Collaborative Learning (CSCL)

Alike with face-to-face collaborative environment, AKC with computer-supported collaborative learning (CSCL) also requires two or more students negotiating and reaches agreement about different matters. The only different is the interaction among students is mediated by computers technology. Several advantages of applying CSCL in AKC are: (1) allows time for in-depth reflection; (2) students have more time to reflect, research & compose their thoughts before participating in the discussion; (3) facilitates learning by allowing students to view & to respond to the work of others and (4) develops thinking & writing skills.

1.10.7 Social Collaborative Learning Environment (SCLE)

With popular technologies and up-to-date instructional trends, distance learning practice and policies are always changing. Currently, online discussion has become one of the medium for students involvement in idea investigation and problem exploration collaboratively and at the same time builds group decision making abilities and advances HOTS (Wilen, 2004). The Web 2.0 has been designed to embrace such collaborative applications and to indicate a social approach to generating and distributing content in networks, characterized by open communication, decentralization of authority, and freedom to share and re-use. One of Web 2.0 applications is social networks or the social collaborative learning environment (SCLE) through which users share and filters content, collaborate, seek information, and interact socially on the Web.

1.11 Summary

The need to analysing students' level of thinking skills and evaluate the process of AKC in online settings has being inspired for conducting this study. The ability to educate students for higher order learning in SCLE context is an important indicator that online learning does enhance the learning processes as compared to the traditional settings. To the best of our knowledge, few studies are conducted on the students' AKC and HOTS in SCLE. Therefore, it is hoped that this research would report on the level of students' thinking skills along with students' AKC process in SCLE and provide ways towards higher level of thinking skills. The following chapter will discuss on the literature review related to this research scope.

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LIST OF PUBLICATIONS

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2. Ibrahim, S. N. K. A., & Harun, J. (2019). *The Influences of Argumentative Knowledge Construction Process in Social Collaborative Learning Environment towards Students' Higher Order Thinking Skills*. International Conference on Education and Social Development (ICESD 2019). **(PROCEEDING)**
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