UNIVERSITI PUTRA MALAYSIA

EFFECTIVENESS OF THE INTERACTIVE E-LEARNING COMMUNITY (*i*ELC) ON THE PRACTICE OF SELF-REGULATED LEARNING FOR SECONDARY SCHOOLS IN KUALA LUMPUR

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In an examination-dominated culture in the Malaysian schools, the current education system has been criticized for lacking in fostering self-regulated learning strategies. Effective practice of self-regulated learning has been perceived as key for learner to succeed academically and after the schooling years. Poor practice of self-regulated learning can result students in being able only to memorize information and reproduce it during examination. Thus, the development of the *i*ELC discussion platform was proposed to complement the traditional teacher-centered instruction and to inculcate the practice of self-regulated learning. The *i*ELC discussion platform is an online discussion platform, developed using the open source Moodle software to encourage students'

participation in an online learning community on the sharing of knowledge and the learning of the Form Four KBSM Physics subject. The objectives of the study were; (i) to develop an online discussion platform termed as the *i*ELC discussion platform; and (ii) to investigate the effectiveness of the *i*ELC discussion platform in advancing the practice of self-regulated learning strategies in the learning process. The pretest-posttest and posttest only non-equivalent research design was employed in this study. The schools were selected in a two-stage cluster sampling technique. In the first stage, two zones in Kuala Lumpur were randomly selected to represent the selection of the experimental and control group. In the second stage, two schools were randomly selected from each of these zones to represent the experimental and control schools, giving a total of four schools. Samples (n = 102) consisted of Form Four Physics students from four regular national secondary schools in Kuala Lumpur. For a duration of eight weeks, fifty students from two regular national secondary schools used the *i*ELC discussion platform and also face-to-face discussion to study the topic of "Kinematics and Motion" in the Form Four KBSM Physics. The other two classes with fifty-two students acted as the control groups and only followed the face-to-face discussion. The Motivated Strategies for Learning Questionnaire (MSLQ) was used to measure the samples' use of self-regulated learning strategies. The instrument consists of several subscales which are intrinsic goal orientation, extrinsic goal orientation, control of learning beliefs, self-efficacy for learning and performance, rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning and help seeking. Two-way analysis of variance was used to analyze the impact of the two independent factors (*i*ELC

discussion platform treatment and administration of pretest) on the dependent variable (self-regulated learning posttest mean scores). The main findings of the study indicated that participation in the *i*ELC discussion platform was significantly effective in encouraging practice of self-regulated learning strategies in the learning process. Participation in the *i*ELC discussion platform was particularly effective in encouraging practice of self-efficacy for learning and performance, rehearsal, elaboration, organization, time and study environment, effort regulation and help seeking. In conclusion, these findings suggest that students' participation in the *i*ELC discussion platform improved their use of self-regulated learning strategies.

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KEBERKESANAN KOMUNITI E-PEMBELAJARAN INTERAKTIF (*i*ELC) TERHADAP AMALAN PEMBELAJARAN KENDIRI UNTUK SEKOLAH MENENGAH DI KUALA LUMPUR

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Dalam budaya berdominasikan peperiksaan di sekolah-sekolah Malaysia, sistem pendidikan telah dikritik kerana kurang menekankan strategi pembelajaran kendiri. Murid-murid yang mempraktikkan strategi pembelajaran kendiri secara efektif berpersepsi untuk berjaya dalam akademik dan selepas zaman persekolahan. Praktis strategi pembelajaran kendiri yang lemah menyebabkan murid-murid hanya menghafal maklumat dan menulis kembali semasa peperiksaan. Oleh itu, pembangunan ruang perbincangan *i*ELC telah dicadangkan sebagai pelengkap kepada proses pengajaran dan pembelajaran tradisional, dan menerapkan praktis pembelajaran kendiri. Ruang perbincangan *i*ELC ialah suatu ruang perbincangan atas talian e-komuniti, yang dibangunkan menggunakan sumber terbuka *Moodle*, untuk menggalakkan murid-murid

berkongsi pengetahuan dan proses pembelajaran mata pelajaran Fizik KBSM Tingkatan Empat. Objektif kajian adalah: (i) membangunkan ruang perbincangan atas talian yang dilabelkan sebagai ruang perbincangan *i*ELC, dan (ii) menyelidik keberkesanan ruang perbincangan *i*ELC dalam menerapkan praktis pembelajaran kendiri dalam proses pembelajaran. Rekabentuk kumpulan kawalan tidak serupa dan rekabentuk perbandingan kumpulan statik telah digunakan sebagai rekabentuk kajian. Sekolah-sekolah yang terlibat dalam kajian ini dipilih melalui teknik persampelan kluster dua peringkat. Dalam peringkat pertama, dua zon di Kuala Lumpur telah dipilih secara rawak untuk mewakili kumpulan eskperimen dan kumpulan kawalan. Dalam peringkat kedua, dua buah sekolah dipilih secara rawak daripada setiap zon ini untuk mewakili sekolah eksperimen dan sekolah kawalan, memberikan jumlah empat buah sekolah. Sampel (n = 102) terdiri daripada murid-murid Tingkatan Empat yang mengambil matapelajaran Fizik dari empat buah sekolah menengah harian biasa di Kuala Lumpur. Dalam jangkamasa lapan minggu, lima puluh murid dari dua buah sekolah menengah akademik biasa melibatkan diri dalam ruang perbincangan *i*ELC dan juga perbincangan secara semuka untuk topic “Kinematik dan Pergerakan” dalam Fizik KBSM Tingkatan Empat. Dua buah sekolah menengah harian biasa lagi dengan lima puluh dua murid bertindak sebagai kumpulan kawalan dan hanya terlibat dalam perbincangan secara semuka. Instrumen *Motivated Strategies for Learning Questionnaire (MSLQ)* telah digunakan untuk mengukur praktis strategi pembelajaran kendiri oleh murid-murid. Instrumen tersebut terdiri daripada beberapa sub-skala iaitu *intrinsic goal orientation, extrinsic goal orientation, control of learning beliefs, self-efficacy for learning and performance, rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort*

regulation, peer learning and help seeking. Analisis Varians Dua Faktor digunakan untuk menyiasat kesan dua pembolehubah tak bersandar (intervensi *i*ELC *discussion platform* dan perlaksanaan pra-ujian) ke atas pembolehubah bersandar (skor min pasca-ujian pembelajaran kendiri). Dapatan utama kajian menunjukkan bahawa penglibatan dalam ruang perbincangan *i*ELC adalah signifikan dalam menggalakkan praktis pembelajaran kendiri dalam proses pembelajaran. Dapatan ini mengimplikasikan cadangan kukuh untuk murid-murid melibatkan diri dalam ruang perbincangan *i*ELC untuk memperbaiki dan mengukuhkan praktis pembelajaran kendiri. Penglibatan dalam ruang perbincangan *i*ELC secara khususnya menggalakkan praktis *self-efficacy for learning and performance, rehearsal, elaboration, organization, time and study environment, effort regulation, help seeking* secara efektif.

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DECLARATION

I hereby declare that this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that this thesis has not been previously or concurrently submitted for any other degree of Master of Science at Universiti Putra Malaysia or other institutions.

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CHAPTER 1

INTRODUCTION

This chapter draws attention to aspects fundamental to the study. The chapter begins with an introduction to the study emphasizing on how overwhelming exposure to traditional directed instruction led to ineffective practice of self-regulated learning strategies, which then generated interest in online learning as the more feasible alternative. The discussion then trails into appreciating the growth of e-learning in the Malaysian educational context which initially escalated from the E-Thrusts policy development. The subsequent discussion brings to attention the need to provide for practice of self-regulated learning strategies. In the following discussion, aspects fundamental to the study were explicated, such as the problem statement, objectives, hypotheses, significance of study, limitations of study and definition of terms.

1.1 Background of the Study

In traditional learning environments, students were normally assessed on their abilities to recall information or to understand fundamental relationships among ideas. Traditional directed instruction is fundamentally teacher-centered and converges on rote and fact-based learning (Neo, 2003). Thus were the reasons why students were mostly encouraged to memorize information and reproduce it during examination (Entwistle, 1995; Entwistle

& Entwistle, 1991). Else, students become passive recipients of knowledge conveyed to them by their teacher whom is considered as sole authority of knowledge (Orlich, Harder, Callahan & Gibson, 1998; Delisle, 1997). Similar instructive concerns have also surfaced in Malaysian classrooms. In an examination-dominated culture in Malaysian schools, students have little say on taking responsibility for their own learning (Multimedia Development Corporation, 2002). Although the educational system was able to produce students with good results (Ng, 2005), the current education system has been criticized for fashioning "mindless memorization and regurgitation of facts and figures, which they do not know how to apply" (Smart School: The Story So Far, 2003, p. 1). Ng (2005) points out that this was due to lack of self-regulated learning strategies practiced during teaching and learning process in schools. Moreover, traditional learning environment was not able to effectively foster skills on self-regulated learning strategies (Tan, 2003; Brooks, Nolan & Gallagher, 2001; Duch, Groh & Allen, 2001). Evidently, a shift from the traditional didactic instruction was necessary. Online learning was perceived to be a more feasible alternative to traditional classroom instruction (Tallent-Runnel, Thomas, Lan, Cooper, Ahern, Shaw & Liu, 2006) following the massive development of the Internet and online technologies. Rosenberg (2001) associates e-learning to the use of the Internet. He stresses on the role of the Internet and Internet technologies to convey and enhance the presentation of knowledge. Rossett and Sheldon (2001) also views online learning as a form of e-learning, by which learning is delivered through a server or a host computer that is linked to the World Wide Web. Hence, it was no surprise that the Malaysian Ministry of Education anticipates considerable use of the Internet in the

teaching and learning process in hope to provoke better learning outcome and learning opportunities.

1.2 Growth of E-Learning in the Malaysian Educational Context

The development of ICT education in Malaysia began with the tabling of the Third Outline Perspective Plan (OPP3). The OPP3 draws attention to some key strategic thrusts to achieve sustainable growth for the nation (Mahathir Mohamad, 2001). As addressed by OPP3, Malaysia is striving toward the status of a developed nation by 2020. This was referred to as Vision 2020. Vision 2020 was aimed to signify Malaysia as a competitive key player in the global economy. The recent OPP3 shift from the Eighth Malaysia Plan to the Ninth Malaysia Plan has made it possible for a substantial amount of resources to be invested in education and training to scaffold the undertaking of technological skills and expertise with high level of thinking skills (Mahathir Mohamad, 2001).

The Multimedia Super Corridor was established to conceive the development of knowledge-based economy (k-economy) in the interests of Vision 2020 (Mahathir Mohamad, 2001). The National Information Technology Council (NITC) was given the mandate to supervise the National Information Technology Agenda (NITA). NITA was developed to initiate and strengthen the production, sharing and exploitation of knowledge (John, 2003), which was perceived as an audacious move to ease Malaysia's

transition into the next nationhood of k-economy. Five E-Thrust Areas were identified and documented addressing E-Learning as one of them (John, 2003).

In view of the reciprocal relationship between k-economy and e-learning, Mahathir Mohamad (2001, p. 24) states that,

> "The knowledge-based economy is where the acquisition, utilization and dissemination of knowledge provide the basis for growth… It will strengthen Malaysia's competitiveness and open up new opportunities for the country… The culture of acquiring knowledge on a continuous basis will be promoted to develop a learning society."

It is evident in Malaysia that the development of online discussion platforms has been relentless since the acknowledgement of e-learning as one of the major E-Thrust Areas. Diffusion of online learning has since stretched across the wide spectrum of the teaching and learning process, ranging from pedagogical concerns to increasing students' performance with e-assessment. Studies have indicated that online learning platforms possess unexplored potential to defy traditional approach of teacher-centered teaching to promote student-centered learning (Jonassen et al., 2003). Participation to online learning also leads to better involvement in the learning process (Picciano, 2006; Reece & Lockee, 2005). Moreover, learning through the Internet also establishes positive impact on student learning to advance collaborative learning strategies (Neo, 2005) and to encourage students' inquiry and reflective thinking skills (Wen, Tsai, Lin & Chuang, 2004).

The smart school system would be an excellent example on the integration of E-Learning in Malaysian educational context. In the context of this study, e-learning referred to the use of the Internet in the teaching and learning process. Smart schools were adopted as

one of the seven flagship applications of Multimedia Super Corridor which acts as an innovative measure to accelerate Malaysia into a knowledge-based society by Vision 2020 (Multimedia Super Corridor Malaysia, 1996).

The Smart School Project was implemented in 1999 with aim to revamp the teaching and learning process in order to prepare the students for the information age (Ng, 2005). Ng (2005) further points out that the teaching and learning process as introduced in the Smart Schools emphasized on students to be the active participant of the teaching and learning process while teachers play the role of facilitators moderating information between students. This shift from teacher-centered teaching to student-centered learning aims to foster practice of self-regulated learning (Malaysian Strategic Research Center, 1994). It is this induction on the practice of self-regulated learning and the use of IT in the teaching and learning process that distinguishes Smart Schools from other schools ("School for Industry", 2002).

In conformity with current theoretical perspectives in online teaching and learning, the smart school system focuses on strategies of self-accessed, self-paced, and self-directed learning (Multimedia Super Corridor Malaysia, 1996). As underlined by the Multimedia Super Corridor Malaysia (1996) prospectus, self-accessed learning allows the learner to access information from various resources such as books, journals, television and the Internet, independent of the teacher. Self-paced learning allows the learner to learn at his or her own pace without being held back by more academically challenged students or having to deal with materials beyond one's capability. Self-directed learning, also

referred to as self-regulated learning (Ng, 2005), allows the learner to engage and investigate topics of interest without being anchored to a rigid curriculum. Overall, the smart school system aims to achieve a "thinking culture in an exam-oriented dominated culture in the present educational system" (Smart School: The Story So Far, 2003). Conclusively, it was the aim of current and future classroom practices to converge on inquiry, and the discovery of knowledge and understanding of subject content (Multimedia Super Corridor Malaysia, 1996).

As for the status of self-regulated learning in Malaysia secondary Smart Schools, Ng (2005) conducted a research in which, the first objective was to identify predictors of self-regulated learning, and the second objective was to develop and test the effectiveness of the Self-Management Tool in guiding students to employ practice of self-regulated learning constantly and practically. To achieve the first objective, a quantitative correlational research design was adopted and the data was collected through the survey method. The sample consisted of 409 students from six randomly selected secondary Smart Schools. Analyzed with multiple regression analysis, it was found that IT-integration, student-teacher interactions, motivational beliefs and self-regulative knowledge were significant predictors of self-regulated learning [$\Delta R^2 = .51$, $F(5,403) = 84.48$, $p < .01$]. To achieve the second objective, a quasi-experimental research design was adopted to test the effectiveness of the Self-Management Tool. A total of 61 students consisted of 30 students from the experimental group and 31 students from the control group were selected from one randomly selected secondary Smart School. In duration of three months, ANCOVA analysis found no true difference in the practice of self-

regulated learning between the experimental and control groups. [$F(1,56) = 2.39$, $p > .05$]. However, in a follow-up study eight weeks after, it was found that students from the experimental group showed significantly higher practice of self-regulated learning than students from the control group [$F(1,56) = 31.04$, $p < .01$]. This implies that the Self-Management Tool was effective in guiding students to practice self-regulated learning constantly and practically.

Unlike the rapid technological development in smart schools, regular national secondary schools which were established during the early stages of education reformation were not as technologically equipped and have only been recently encouraged to provide more e-learning conducive environment. Moreover, study of literature review found that there has not been any extensive study of self-regulated learning in regular national secondary schools as compared to studies on self-regulated learning conducted in secondary Smart Schools.

1.3 Understanding the Need to Provide For Self-Regulated Learning Strategies

In recent years, online teaching and learning are rapidly gaining attention. Scholars assert that online education possesses the capacity to encourage self-regulated learning strategies (Hartley & Bendixen, 2001; Hill & Hannafin, 1997). By definition, Pintrich (2000) establishes self-regulated learning as an active and constructive process where students set goals, monitor and regulate their learning process. In further view of self-

regulation, Ruohotie (2002) establishes that preceding performance in self-regulation process is able to direct new efforts. This implies that self-regulated learners were more inclined to engage in the transfer of knowledge to real-world situations (Driscoll, 2005; Mayer, 2002). It is evident that self-regulation should not be viewed individually as mental ability or an academic performance skill, but as a self-directive process in which the learners hone their respective mental abilities into academic skills (Zimmerman, 2002). Effective practice of self-regulated learning strategies allows for active processing of information (Murray, 2000), which leads to academic success (Boekaerts, 1997). Self-regulated learning strategies were more strongly advocated through formal education, and were the means through which students were prepared for after the schooling years (Boekaerts, 1997). Studies indicated that there is a coherent positive relationship between the practice of self-regulated learning strategies and academic achievement (Pintrich, 1999; Pintrich & De Groot, 1990).

1.4 Problem Statement

In the current tradition teaching and learning process in schools, students were mostly only gauged on their ability to recall factual information but rarely on understanding relationship between concepts. Similar instructive concerns have also surfaced in Malaysian classrooms. In this teacher-centered teaching approach, the teacher visibly dominates the classroom while the students only anticipate on receiving knowledge submissively from their teachers. Students were mostly encouraged to memorize

information and reproduce it during examination. In an examination-dominated culture in Malaysian schools, students have little say on taking responsibility for their own learning (Smart School: The Story So Far, 2003). In the Malaysian educational context, although the educational system was able to produce students with good results, the current education system has been criticized for fashioning lack of self-regulated learning skills (Ng, 2005; Smart School: The Story So Far, 2003). Consequently, students only have little opportunity to raise, test and retest their understanding of the subject content which again leads to minimal students' participation in the teaching and learning process. Pedagogically, practice of learning strategies are not optimized when students are engaged in teacher-centered teaching environment.

Thus, the development of the Interactive E-Learning Community (*i*ELC) Discussion Platform was proposed to complement the traditional directed instruction and to inject improved practice of self-regulated learning. The *i*ELC discussion platform is an online learning community developed by the researcher to advance practice of self-regulated learning strategies in the teaching and learning process through interaction with students from other regular national secondary schools. Over time seeing the development of smart schools, concerns were raised for regular national secondary schools. Deprived of financial assistance and with just enough ICT infrastructures, how were these schools to remain at par with the development of Smart Schools in terms of actively engaging students in the teaching and learning process? Hence, implementation of the proposed online discussion platform was anticipated in regular national secondary schools.

Moreover, in a study examining the predictors of self-regulated learning and the testing of a Self-Management Tool in six randomly selected secondary Smart Schools, Ng (2005) found that IT-integration, student-teacher interactions, motivational beliefs and self-regulative knowledge were significant predictors of self-regulated learning. However, review of literature found that there has been no such extensive study as described above to examine effective practice of self-regulated learning in regular national secondary schools. Hence, this study provided strong literature concerning the need for and means of achieving effective practice of self-regulated learning in regular national secondary schools.

1.5 Objectives of the Study

The objectives of the study were:

i) To develop the proposed online discussion platform termed as the *i*ELC discussion platform; and

ii) To investigate the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning strategies in the learning process.

1.6 Hypotheses of the Study

The following hypotheses were formulated based on literature reviews of self-regulated learning and the Pretest-posttest and Posttest Only Nonequivalent Group Design. These

hypotheses were aimed to test the effectiveness of the *i*ELC discussion platform in advancing the identified learning strategies.

For objective (ii), to investigate the effectiveness of the proposed *i*ELC discussion platform in advancing self-regulated learning strategies in the learning process, the following hypotheses were tested:

H1: There was a significant testing main effect between the pretest and non-pretest groups on self-regulated learning posttest mean scores;

H2: There was a significant treatment main effect between the experimental and control groups on self-regulated learning posttest mean scores; and

H3: There was a significant interaction effect between the testing effect and treatment effect on self-regulated learning posttest mean scores

1.7 Significance of the Study

Findings of this study surfaces two critical implications that provides convincing justifications for continued research in these areas of the teaching and learning process. First, the study emphasizes importance on the practice of self-regulated learning in the teaching and learning process. Effective practice of self-regulated learning allows for active engagement in the learning process and this has strong implications on the learner and the learning process (Curtis & Lawson, 2001; Garcia & Pintrich, 1994; Schunk & Zimmerman, 1994). Second, the study provides strong evidence to exploit the use of the

Internet in secondary education. Parallel to rapid development of instructional technology, it was imperative to investigate on potential online discussion platforms to amplify students' participation in the teaching and learning process. Studies by Wen et al. (2004) and Le and Le (1999) indicated that learning through the Internet ascertains positive bearing on students' learning process including inquiry learning, reflective thinking and to engage in autonomous and interactive learning. Kinzie (1990) argues that autonomous learning leads to effective practice of self-regulated learning.

These findings warrant benefit to teacher educators by providing them with a critical perspective for further and continued investigation on advancing practice of self-regulated learning in the teaching and learning process. Second, the study found that participation in the *i*ELC discussion platform improves practice of Elaboration, Help Seeking, Time and Study Environment and Effort Regulation.

These findings suggested strong implication for teacher educators to infuse use of the Internet in their classroom teaching to improve practice of self-regulated learning strategies. On the other hand, the study discovered that participation in online discussion platform was not very successful in encouraging practice of intrinsic goal orientation, task value, self-efficacy for learning and performance, metacognitive self-regulation, peer learning and critical thinking. These findings also benefit teachers and teacher educators by providing them grounds for further investigation of participation in online discussion platform to identify the reasons that led to low practice of these strategies.

The study again warrant benefit to teacher educators by providing them with a robust guideline to advance and amplify practice of self-regulated learning through participation in the *i*ELC discussion platform. These guidelines include the complete design and development phases of the *i*ELC discussion platform employed in this study should teacher educators decide to develop another online discussion platform that shares similar characteristics with the *i*ELC discussion platform.

The study also warrants benefit to the relevant authorities in the Ministry of Education (MOE) by creating awareness on the importance of effective practice of self-regulated learning strategies in the teaching and learning process. Practice of these strategies offers an insight on how students in lower percentiles can achieve better academic achievement. Second, the study unearthed significant findings to the relevant authorities of MOE by presenting an initiative on testing the use of open source Moodle software. The Moodle software was used as the basic development tool for the *i*ELC discussion platform to be used in secondary schools. When MOE cannot discriminate on introducing opportunities of teaching and learning through the Internet to schools due to financial concerns, Moodle acts as an excellent example of cost-effective software that is highly customizable and is able to accommodate large community of students and teachers. Moreover, the study also has provided complete design and development phase guideline for further investigation of online discussion platforms to be used in the teaching and learning process in secondary schools.

1.8 Limitations of the Study

The following discussion acknowledges several limitations of the study. One of the most apparent limitations was in the terms of the accessible population. This study was only able to focus on regular national secondary schools in Kuala Lumpur. Moreover with concern to time and financial constraints, only two schools were selected for each experimental and control group in the Pretest-Posttest and Posttest Only Nonequivalent Group Design. The study focused on Form Four students because it was a non-examination class and has the most learning experiences compared to students from other forms (Ng, 2005). Based on these grounds, it must be noted that the findings of this study were not feasible to be generalized beyond the parameters of this study and of similar studies.

Another limitation of the study was the use of self-rating instruments. The limitation of the instruments points out to the fact that only self-rating instruments were used to measure the practice of self-regulated learning strategies in this study. Use of self-rating instruments was opted for several reasons. Firstly, the study was directed towards quantitative analysis which requires assessment of average mean scores instead of individual mean scores, and was thus best accomplished using self-rating instruments (de Vaus, 2001). Secondly, use of self-rating instruments was less time consuming and requires less professional expertise as compared to structured interview method.

However, it was acknowledged that use of self-rating instruments did pose some disadvantages. Self-rating instruments might possibly compel respondents to react to a more customary and satisfactory response (Ng, 2005). Hence, the data collected might not justly represent their true response. Hence, as caution to minimize these 'customary and satisfactory response', clear written and oral directions were given before the respondents were to answer the questionnaires.

The written and oral directions informed the respondents that there were no correct or wrong answers and that the respondents were to answer the questionnaires honestly. Above all, the respondents were assured that the questionnaires were strictly confidential and were subjected only to the researcher. These measures were to further ensure that respondents were at ease to respond honestly.

1.9 Definition of Terms

The following details aims to address terms that were used in the documentation of the study. These definitions of terms constitute the conceptual and the operation definitions. The conceptual definition refers to characterization based on conceptual or hypothetical criteria (Tuckman, 1999). That is, conceptual definition addresses the meaning of a concept by reference to another concept in the context of this study. The operational definition refers to the characterization based on the observable attributes of the object being defined (Tuckman, 1999).

1.9.1 Self-Regulated Learning

According to Santrock (2001), self-regulated learning refers to strategies used to produce self-generation and self-monitoring of thoughts, feelings and behavior in order to achieve an objective. Self-regulated learning strategies incorporate self-regulatory processes, task strategies and self-motivational beliefs (Cleary & Zimmerman, 2004). Self-regulation processes include goal settings, self-observation and self-evaluation while task strategies include study, time management and organizational strategies, and self-motivational beliefs include self-efficacy and intrinsic interest. In this study, self-regulated learning strategies refer to the skills used to engage in the proposed online discussion platform. These skills may include posting and answering questions in forums, participating in classroom group activities and obtaining comprehensive information from the Internet in the teaching and learning process of Form Four Physics subject.

1.9.2 Moodle

Moodle is acronym for Modular Object-Oriented Dynamic Learning Environment (Dougiamas, 1999). Moodle is based on Open Source Software (OSS) under the GNU Public License (GPL). The Moodle software was designed to operate on PHP scripts, MySQL database and Apache web server. In this study, Moodle refers to the software that was used to develop the proposed online discussion platform.

1.9.3 Constructivism

Constructivism is a theoretical pedagogy that focuses on construction of knowledge through interaction with the learning environment (Dougiamas, 2006). In the context of this study, constructivism is an integrated component of the proposed *i*ELC discussion platform theoretical and is practiced for optimal student-centered learning.

1.9.4 The *i*ELC Discussion Platform

The *i*ELC Discussion Platform is acronym for Interactive E-Learning Community Discussion Platform. The proposed *i*ELC discussion platform is form of an online discussion platform developed using open source Moodle software and focuses to engage randomly identified groups of students in the Form Four Physics KBSM subject through deliberately selected online and classroom learning tasks.

1.9.5 E-Learning

Rosenberg (2001) associates e-learning to the use of the Internet. He stresses on the role of the Internet and Internet technologies to convey and enhance the presentation of knowledge. In the context of this study, e-learning refers to participation in the *i*ELC Discussion Platform.

1.9.6 Online Learning

Rossett and Sheldon (2001) views online learning as a form of e-learning, by which learning is delivered through a server or a host computer that is linked to the World Wide Web. Online learning can be defined as a teaching and learning approach that employs some form of Internet technologies to communicate and collaborate in an educational context (Blackboard, 2000). In the context of this study, online learning refers to participation in the *i*ELC Discussion Platform, which is conducted in a blended learning environment. This definition of online learning tailored to the context of this study can be supported by Blackboard (2000) view on online learning which states the utilization of Internet technologies to complement the traditional teaching and learning environment, and that this teaching and learning process is experienced online.

1.9.7 Blended Learning

Blended learning brings together the advantages of the two learning environments which are classroom-based learning and e-learning (Bonk & Graham, 2006; Hysong & Mannix, 2003); Verma, 2002; Masie; 2002). Moreover, participation in a blended learning environment combines a mix of delivery methods that possesses the potential to cater to various learning needs of a diverse audience (McSporran & King, 2005). According to Rossett (2002), blended learning may include blended classroom instruction with online instruction. In the context of this study, blended learning referred to the mixed delivery methods in the teaching and learning approach conducted continuously through face-to-face classroom participation and in the *i*ELC Discussion Platform.

1.9.8 Traditional Teaching and Learning

The traditional teaching and learning approach usually focuses on teacher-centered teaching which results cookbook steps of activities and demonstrations (Udovic, Morris, Dickman, Postlethwait & Wetherwax, 2002). The traditional teaching and learning approach also provide students with little, or none, valuable learning skills (Udovic et al., 2002). In the context of this study, the traditional teaching and learning approach referred to face-to-face teaching in a conventional classroom with no chances of utilizing any form of e-learning or online learning as defined in the context of this study.

1.10 Chapter Conclusion

This chapter outlined the aspects fundamental to the study, which included background of the study, growth of e-learning in the Malaysian educational context, the need to provide for self-regulated learning strategies, problem statement, objectives of the study, hypotheses of the study, significance of the study, limitations of the study and the definition of terms. The following chapter will put forward a review of literature on the theoretical aspects that make up this study.

CHAPTER 2

LITERATURE REVIEW

This chapter brings to attention a review of literature relevant to the study. The review of literature begins by putting forward the need for a new learning paradigm, and traces briefly to the fundamentals of the learning process. Discussion then focuses into the

learning theories, discussing briefly on the behaviorism and cogntivism theories of learning. Discussion then channels into the constructivism theory of learning, which acts as the theoretical foundation of this study. This chapter also put forward discussion on the role teachers as facilitators to the teaching and learning process. This topic is imperative to understand the need to challenge the traditional teaching and learning environment to advance an active, student-centered learning environment. Attention is then focused briefly towards learning through the Internet and continues to describe Moodle as open source software. The chapter then put forward a conceptual understanding to the practice of self-regulated learning in the teaching and learning process, and continues to describe the Motivated Strategies for Learning Questionnaire (MSLQ) as the instrument used to measure self-regulated learning. This chapter also discusses in theory on the ADDIE Instructional Design model which was used to develop the *i*ELC discussion platform. Finally, discussion on this chapter ends with description on the theoretical framework and the conceptual framework of the study.

2.1 The Need for a New Learning Paradigm

In the dawn of the knowledge era, a new learning environment paradigm is absolutely necessary to provoke the transfer and sharing of information as a whole. Undeniably, this shift has been reflected of its importance considering seriously that the aspiration of the education discipline has begun to revolutionize to further reflect on innovative, social and educational needs. This is particularly true when more and more information is becoming

available through the profound use of technology. Also, through the diffusion of these technological advances, one may scrutinize the worth of information while others may conform to it. In other words, meaningful learning is almost impossible to achieve without crossing over and sharing the boundaries of another discipline.

According to Duch et al. (2001), students must have the capability to function in a global working world as forthcoming professionals will be expected to solve problems that crosses disciplinary margins and subsequently demand for a more innovative and complex problem-solving skills. Referring to the context in which exists the reciprocal transfer and sharing of knowledge between two or more disciplines, one could not circumvent from being an integral part of the curriculum. Evidently, the central task of the curriculum is to ensure that students will benefit with optimum revenue from the continuous amplification of knowledge as well as to contribute productively to one's respective profession. Furthermore, the curriculum steers and regulates an individual to a learning process that allows for the acquisition of an array of skills, for instance, workplace competencies, self-regulated learning, teamwork and leadership, which prepares the individual for the realization of the real-world standpoint.

As a conclusion, it is evident that there is a need for a new learning paradigm sustained by the curriculum in which students are well equipped with the necessary skills, such as self-regulated learning, teamwork and problem-solving to allow them to function effectively in a working environment. To achieve these skills, students must engage collectively in the sharing of knowledge.

2.2 Fundamentals of the Learning Process

Roblyer, Edwards and Havriluk (1997) points out that the learning process as well as the product of the learning process is more productive in an active learning environment rather than the traditional learning environment. Roblyer et al. (1997) further defines the traditional method as an approach that obliges students to submissively grasp and regurgitate information as and when conveyed by the teacher. Indeed, the traditional approach is more teacher-centered as the teacher is viewed by the students as the only source of information.

In a traditional teaching and learning environment, only little learning is taking place in the classroom even though there appears to be an active shift of information. Thus, students thrive in an active, student-centered learning environment because it emulates a real-world learning environment. Hence, it is necessary to bring about a two-way transfer of knowledge as it requires optimum students' participation.

Duch et al. (2001, p. 4) also mention that in a traditional learning environment, the teaching and learning processes were usually…

> "… content-driven, emphasizing abstract concepts over concrete examples and application rarely challenge students to perform at higher cognitive levels of understanding. This didactic instruction reinforces in students a naïve view of learning in which the teacher is responsible for delivering content and the students are the passive receivers of knowledge."

From the views addressed above, it is evident that participation in a student-centered learning environment is necessary and acts as the underpinning in bringing about active learning. Ertmer and Newby (1993) establish the meaning of learning as a continuous developmental process in which one constructs an individual understanding of the environment through specific experiences and interactions with the surrounding. Savery and Duffy (1995) also indicated that learning is a process which is a result of interacting with the environment. To be more specific, Santrock (2001) defines learning as a "… relatively permanent change in behavior that occurs through experience" (p. 238). Ormrod (2000) also states that learning may be viewed as a relatively permanent change in mental associations due to experience.

Thus, theorists and educationists came to a standpoint that one will not be able to completely comprehend the learning process and value the outcome of the learning process without bringing into context the notion of the behavioral change as well as the cognitive change. Given the increasing importance of this notion in constructing a functioning learner-centered environment, hence it was suggested the cognitive theory of learning to compensate and complement for the shortfall of the behavioral approach. In context on the correlation between experience, learning and learning theories, Tan, Parsons, Hinson and Sardo-Brown (2003) assert that learning theories makes clear how one is steered towards learning, a relative yet undeviating process, through experience. In other words, learning theories adopts a systemic account of the numerous standpoint in which theorist perceives how one is changed, or rather learn, by his or her experience. From this statement emerges a mutual understanding between educationists and

educational psychologists on how a learning theory supports a particular learning process in a particular learning environment, although Tan et al. (2003) testify that there are still differing notions on the specific details of "how", "when", and "how best".

According to Tan et al. (2003), most of the times, learning takes place unintentionally and that one may not even realize it. This scenario is usually frequent when one is not engaged in a formal learning environment or a particular subject matter. Second, learning may or may not address any specific observable change in attitude although one has undergone a learning process. In the case where learning is unintentional, unobservable change may be perceived as customary.

However, in the case where learning is intentional, realization may hit only when one is engaged in scenario which requires the particular skills of the learning process. This particular scenario is called the principle of contiguity, and the concept of "learning via association or contiguous learning" (Tan et al., 2003, p. 202). Third, there are different types and degrees of learning. For instance, learning may consist of a simple, mechanistic task (e.g., instincts or reflexes) to a more complex and organized task (e.g., solving a quadratic equation).

As a conclusion of this topic, attention is focused on the need to create an active, student-centered learning environment in which students could actively participate in the teaching and learning process. Numerous studies have indicated that students involves enthusiastically in a learning environment that replicates a real-world learning

environment. Moreover, traditional learning environment places the student in a passive role that only allows them to unreceptively absorb and regurgitate information.

2.3 Learning Theories

In view of these premises of learning, Tan et al. (2003) mention that it is evident that theories were, in fact, reasoned explanations, rather than absolute fact, to approach a particular phenomenon. In the discussion that follows, attention will channeled towards appreciating and discriminating the context in which the constructivist approach is justified in an active, student-centered learning environment. But prior to it, the behaviorism and cognitive theories of learning will be discussed briefly in the subsequent paragraphs for deliberate purposes of appraising the advantages of the constructivism approach in student-centered learning.

Referring to the definition of behaviorism, Santrock (2001) indicated that behavior should be explained by experiences that can be directly observed and measured. In other words, Tan et al. (2003) mention that behaviorism can be perceived as a theoretical perspective, or rather an alternative explanation, to measure experiential changes after one has been subjected to a learning process. According to Ormrod (2000), the cognitive psychology may be defined as a theoretical perspective that focuses on the mental processes underlying human behavior. Being more specific in terms of learning, Tan et al. (2003) point out that cognitive theory of learning may also be viewed as a theory in which learning is equated with changes in the organization and use of internal framework

of knowledge. As opposed to the behavioral theory, the cognitivist attempts to understand the response of the learner when the learner is subjected to a particular stimulus.

Gage and Berliner (1998) assert that this attempt to understand may be described in the manner in which the mind processes the information acquired by the learner from the stimulus-response interaction. But the cognitivist do share some similar grounds with the behaviorist with the fact that cognitivist were also concerned with the observable behavior that the learner may show before, during and after the learner is subjected to the stimulus-response interaction. This is mainly because the mind can only be understood by its explicit behavior. However, cognitivists were more likely to perceive the regulation of behavior as "internal to the learner" (Gage & Berliner, 1998).

Another prominent school of thought that appears as a complement to the behaviorism theory of learning would be the cognitive theory of learning. Wong (2002) points out that cognitive theorist use observable and measurable outcome in behavior as a means of conjecturing what goes on in a person's mind. As opposed to the behaviorism theory of learning, advocates of this discipline were more inclined to appreciate and discriminate the factors that prompt the learner to initiate the wheels of the mind.

According to Santrock (2001), there were four fundamental cognitive approaches to learning mainly the social cognitive approach, cognitive information processing, cognitive constructivist and social constructivist. The social cognitive approach gives emphasis to the interaction of behavior, environment and person (cognitive) as

determinants to influence the learning process. Second, the cognitive information processing approach accentuates on the process of administering information through cognitive processes such as attention, memory and thinking. Santrock (2001) underlines the parameters of these cognitive processes as the following; attention is the ability to concentrate and focus on mental resources, memory is the retention of information over time while thinking involves manipulating and transforming information in memory by developing concepts, to reason and think critically and solve problems. The cognitive constructivist approach brings to light the learner's cognitive construction of knowledge and understanding. Finally, the social constructivist approach puts deliberate attention in the learners' collaboration with others to bring about knowledge and understanding (Santrock, 2001).

As a conclusion of this topic, attention is channeled briefly toward the types of learning theories such as behaviorism and cognitivism which emerged prior to the constructivism theory of learning was established in the teaching and learning process. The behaviorism theory points out that learning is a behavior can be observed and measured. On the other hand, the cognitivism theory perceives the regulation of behavior to be internal to the learner. The cognitivism theory is divided into four fundamental approaches, which are the social cognitive approach, cognitive information processing, cognitive constructivist and social constructivist. The following topic continues to describe the constructivism theory of learning. The subsequent, profound progress of the marriage on the behaviorist and cognitive theory of learning yielded yet to one more significant development of the

constructivism theory of learning which has successfully encapsulated the notion, vision and mission of the education discipline.

2.4 Constructivism Theory of Learning

Roblyer et al. (1997) accentuates on the fact that constructivists focus on what drives the students to learn, achieve and to efficiently comprehend and utilize what they learn outside the four borders of the classroom. According to Santrock (2001), learning is best achieved when the individual actively construct knowledge and understanding. That is, individuals must actively participate in the teaching and learning process, thus to discover, to reflect and to think critically on the knowledge they acquire (Richardson, 2003). Hence, the constructivist approach does not allow for rote memorization but encourages the construction of meaningful knowledge and understanding. For these reasons and more, the constructivist approach to learning is perceived as a theory of student learning rather than as a theory of teaching (Richardson, 2003). According to Richetti and Sheerin (1999, p. 58) the fundamental to the constructivist theory of learning is the acknowledgment of the learner as a thinker with capability and value. "After all, why would we need to understand the student's point of view if the teacher's view is the only one that matters?"

Hendry, Frommer and Walker (1999) accentuates the fact that one's sensations, perceptions and knowledge cannot exist outside one's mind and this is a fundamental

assumption in the constructivist approach. To say, knowledge cannot be transferred from one individual to another by any process of replication, and hence, new knowledge must be constructed from within the individual and their interaction with their surroundings (Hendry et al., 1999). Also, knowledge is reinforced and amplified if the knowledge is applied effectively to a wider environment of the individual (Dougiamas, 1999). However, education allows for an individual to deliberately promote the construction of specific knowledge through the use of structured materials, time and other individuals (Hendry et al., 1999).

Thus, the reason Flavell and Piaget (1963) points out that as early as the year 1929, Alfred North Whitehead has put forward arguments that the typical approach in the teaching and learning process in which the students were subjected to in schools have only managed to produce inert knowledge. In other words, this inert knowledge is only good to be used to answer questions on a school test but is not effective in solving problems in real life (Flavell & Piaget, 1963). The social constructivism theory of learning grew from the dissatisfaction with the then current educational methods employed in the teaching and learning process which failed to yield optimum learning outcome as the educationist perceived, such as use of rote memorization, regurgitation of facts and the division of knowledge into different subjects, which ultimately led the learners to a situation where they were not able to apply what they have learned in real life (Dixon-Kraus, 1996).

Furthermore, the teaching and learning process in a traditional rationalist and behaviorist approach focuses on covering extensive subject area, which causes the students to have less amount of time to engage in thinking beyond the facts and problem-solving, and consequently minimizing independent and autonomous learning (Holt & Willard-Holt, 2000). These traditional rationalist and behaviorist approaches to learning also puts more emphasis on didactic lectures rather than addressing importance to active student learning (Holt & Willard-Holt, 2000). These students being deprived of fundamental approaches to learning due to traditional teaching and learning methods, therefore, also lack other important learning skills, for instance, problem-solving skills (Tan, 2003; McMahon, 1997), critical thinking and higher order thinking skills (Tan, 2003) and autonomous learning skills (Holt & Willard-Holt, 2000).

This new-found view of effective outcome of learning gave way to the notion that instructors should only provide the students with appropriate learning situations, such as problem-solving approach (McMahon, 1997) that will instigate and foster their skills in developing their individual knowledge and skills that will be useful to them in their later life (Flavell & Piaget, 1963). Evidently, problem-solving context is perceived imperative and necessary for engaging students in the reflective use of knowledge in the teaching and learning process (McMahon, 1997).

In addition, constructivism theory of learning perceives that the learning process is constructed of creation of knowledge through interpretations of their experiences and their interactions with other individuals, rather than viewing learning as an internal

process of knowledge transfer, in which knowledge is transferred from the individual's external environment into their memories (McMahon, 1997; Flavell & Piaget, 1963).

The social constructivism theory accentuates on the presence and the role of dynamic interaction between individuals involved in the learning environment, for instance, between one learner and another, between a learner and the instructor, and the assigned learning task (McMahon, 1997). This interaction between individuals and the learning tasks allows for an optimal learning environment in which the learner possess the opportunity to construct their individual understanding from the presence of the dynamic interaction available (McMahon, 1997).

Kim (2001) points out the three basic assumptions, or perspectives, that underlie the premises of the social constructivism theory of learning; that is, reality, knowledge and learning. In the social constructivist approach, reality cannot be discovered: it does not exist prior to its social creation. Advocates of the social constructivism approach asserts that reality is constructed through human activity (Kim, 2001), hence, the perception that members of a society work mutually to invent the properties of the world (Kukla, 2000). In the knowledge perspective of the social constructivism, knowledge is established as a human product, and is constructed socially and culturally (Ernest, 1999; Gredler, 1997, Prawat & Floden, 1994).

That is, the creation of knowledge is derived from interaction between individuals and their respective environments, and resides within cultures (Schunk, 2000; McMahon,

1997). In other words, individuals create the meaning of learning through their individual interaction with each other and with the environment that they live in (Kim, 2001). Ultimately, in the learning perspective, the learning is viewed by social constructivist as a social process, by which individuals who were actively engaged in social activities brings about meaningful learning (Kim, 2001). In addition, McMahon (1997) asserts that the learning process is not a passive development of behaviors that are shaped by external forces, to take place only within an individual (McMahon, 1997).

As a conclusion, this topic on the constructivism theory of learning brings into discussion the many advantages of this learning theory in encouraging optimal students' participation in the teaching and learning process. The constructivism theory of learning is supported by numerous review of literature that highlights the role of the student as an active participant and the teacher as a facilitator in moderating the knowledge in a teaching and learning process.

2.5 Teachers as Facilitators of the Teaching and Learning Process

A teacher plays an important role in providing an engaging teaching and learning environment. Dolmans, Wolfhagen, Schmidt and Van der Vleuten (1994) argues that a teacher's performance towards his or her teaching assumes an important influence on the quality of an educational program, and eventually on the competence of graduates. In a similar point of argument, Albanese (2004) asserts that the function of the teacher alone is able to flourish or crush the outcome of students' participation in the teaching and learning process. In the traditional teaching and learning environment, teacher normally

dominated the classroom instruction while students passively receive the knowledge conveyed by the teacher.

Boud and Feletti (1991) also points out to the lack of students' participation in a traditional teaching and learning environment. Boud and Feletti (1991) asserts that conventional teaching and learning process was criticized for the inadequate awareness in encouraging teamwork and development of skills of enquiry. Normala Othman and Maimunah Abdul Kadir (2004) also points out that in the traditional teaching and learning environment, students are spoon-fed with information from textbook materials.

Hence, it was an absolute necessity for students to take the dominant role in the teaching and learning process. Ng (2005) argues that optimal students' participation in the teaching and learning process is imperative to ensure the students are able to effectively practice self-regulated learning strategies. In order to achieve these skills and qualities, it is imperative for the students to have more time for reflection of what they have studied, for deliberate reflective reading, for assimilating the best of the original literature in each field. Given these circumstances, teachers should encourage student-centered learning rather than teacher-centered teaching.

The shift in the teacher's role from a dominant information feeder to a facilitator offers, as Normala Othman and Maimunah Abdul Kadir (2004, p.4) puts it, create "many unique opportunities for teachers to build relationships with students as teachers may fill the varied roles of coach, facilitator, and co-learner". Moreover, a healthy student-teacher

interaction weighs profoundly in a learning process, and is seen as a major scaffolding of knowledge for the learner. Hendry, Ryan and Harris (2003) further argue that some teachers were too dominant in their teaching. A teacher being too dominant in his or her teaching may trigger tension and conflict in a group which may eventually lead to lack of commitment, cynicism and/ or student truancy. On the other hand, if the teacher is too submissive, then the students as well as the learning process might also come to a halt.

As Charlin, Mann and Hansen (1998, p. 324) establishes,

> "Learning that occurs in a meaningful context will also be more easily retrieved than that which is acquired in isolation. The similarity between the context for learning and the context of future application facilitates the transfer of knowledge. However, many different contexts must be experienced in learning to build a fund of connected, usable knowledge."

Therefore, the teacher should play the role of a mediator conveying and digesting information from one situation to another. Steinert (2004) stresses that student appreciates a teacher that is able to relate, expand and digest the present situation into other situations. Therefore, it is evident that a teacher who fails to be equipped with the appropriate skills in delivering information might actually disrupt the entire teaching and learning process. Thus, as Margetson (1994) suggests, the chief task the teacher is to assume is to make certain that the students make progress towards digesting the aim of the subject content as they identify what is needed to be learned, and establish how they will organize themselves to pursue the learning in preparation for the next lesson.

In a student-centered learning environment, teachers were encouraged to question, probe, encourage critical reflection (Margetson, 1994), provide necessary and adequate information, abstain from harsh feedback, and become fellow learners (Aspy, Aspy & Quinby, 1993). Moreover, teachers should also establish an environment that puts students at ease to voice his or her opinion and not get penalize for the 'wrong answer' or succumb to ridicule by their peers. For instance, the trainer should create an environment where students may make mistakes or to simply admit not knowing the answer (Mierson & Freiert, 2004).

Review of literature also strongly suggests for teachers to advance practices of peer learning in a student-centered learning environment. Peer learning were often the preferred choice as it is normally perceived as a complement to the repertoire of instructional activities. Peer learning is also an essential strategy in effectively practicing self-regulated learning strategies (Pintrich, Smith, Garcia & McKeachie, 1991). Boud (2001) characterizes peer learning as a reciprocal learning activity that benefits both the participants and acquiring shared knowledge, ideas and experience. Sampson and Cohen (2001a, b) asserts that individual instructors believe that peer learning frequents the students' occurrence of learning as it allows them to share information and experiences with their peers as well as developing the skills to acquiring information. Boud (2001) further stated that mutual learning assumes much weight in the learning process given that the vital skills of effectively learning from each other were needed in life and work. In the following, Boud (2001) brings to attention some of the potential learning outcomes of peer learning: (i) working with others, (ii) critical enquiry and reflection, (iii)

communication and articulation of knowledge, understanding and skills, (iv) managing learning and how to learn, (v) self and peer assessment, and (vi) self-directed learning.

Santrock (2001) also managed to bring into discussion some, though not limited to, of the characteristics and role of teachers in an active learning environment. First, teachers should adapt their instruction as accordingly to the developmental levels of the students. Teachers were suggested to monitor students' learning cautiously as each student receives, analyze, assess and reflect information at various levels. For instance, the Bloom's Taxonomy provides for an excellent alternative to manage and monitor students' learning.

One of the ways would be for teachers to construct learning objectives based on the six levels of knowledge, understanding, application, analysis, synthesis and evaluation.
Second, teachers should pay attention to individual differences in learning. This is especially true when each student is unique and he or she comprehends information at different pace and ease. Taking into account these individual differences, teachers must take the initiative to engage them in active learning. Santrock (2001) further mentioned that teachers play various roles in bridging the students and the learning process. Evidently, meaningful learning does not only takes place in the classroom but more importantly includes and reflects on the students' experiences. Third, teachers must constantly assess their students as an integral dimension of the teaching and learning process. For instance, teachers must analyze the students' perception of their expected

learning outcome and compare it to the learning objectives outlined in the course structure.

As a conclusion, this topic highlights on the important role a teacher shoulders in shifting students from a passive role to an active role in a teaching and learning process. Specifically, some characteristics of a teacher as grounded in the constructivism theory of learning are established. For instance, teachers are encouraged to guide students to critically reflect on knowledge they acquire and to encourage teamwork among students.

2.6 Learning through the Internet

Although pedagogical practices within the context of electronic environments do merit student learning, however, effective pedagogy approaches within these environments is subject to doubt (Matuga, 2001). The chief reason for this concern is the fact that electronic pedagogy is usually addressed in isolation to other pedagogical concerns such as course curriculum, pedagogical style of the instructor and the characteristics of student learners (Matuga, 2001). Jonassen et al. (2003) forwards an argument that learning through the Internet encourages better student-centered learning environment compared to the traditional, didactic approach of teaching and learning. Numerous studies have also indicated that learning through the Internet does establish positive impact on student learning. This includes, among some, encouraging students' inquiry and reflective

thinking (Wen et al., 2004), independent and interactive learning (Lê & Lê, 1999) and collaborative learning (Neo, 2005).

However, it often appears to be a predisposition for the Internet to be used in traditional ways (Dehoney & Reeves, 1999) which results in electronic versions of a traditional course (Hong, Lai & Holton, 2003). Hence, it necessary to point out that awareness on these escalating cases of these "e-traditional" courses is very important considering that technology is usually seen to be embedded in the teaching and learning process but in most cases it fails to reflect on practice of important learning strategies (Dehoney & Reeves, 1999) like self-regulated learning.

In a conclusion, factors that contribute to ineffective use of the Internet were numerous and thus beyond the scope of discussion. However, Hong et al. (2003) argue that the key reason for this is poor regulation on the use of computers and the Internet in the teaching and learning process in which the teacher still dominates the classroom while the students still passively absorbs spoon-fed knowledge.

2.7 Moodle as Open Source Software

Moodle is a software package with the chief purpose of producing Internet-based courses and websites. Moodle provide for an Internet-based interface for collaboration, activities and critical reflection, and is an ongoing development project specifically designed to

support the social constructivist framework of education (Cornell College, 2003). The Moodle software only started out as a doctoral thesis by Martin Dougiamas entitled "The use of Open Source software to support a social constructivist epistemology of teaching and learning within Internet-based communities of reflective inquiry" in Curtin University of Technology (Dougiamas, 1999). Moodle is acronym for Modular Object-Oriented Dynamic Learning Environment. The Moodle software replicates a learning management system (LMS). Dougiamas (1999) points out that Moodle is also a verb that describes the process of "lazily meandering through something, doing things as it occurs to you to do them, an enjoyable tinkering that often leads to insight and creativity." This verb illustrates the notion of the developer of the Moodle software in addressing the teaching and learning process in an online course.

Moodle is based on Open Source Software (OSS) under the GNU Public License (GPL). Refer to http://moodle.com/ for the license agreement on Moodle. Perens (1997) states that this implies that the Moodle software is copyrighted but the user is free to copy, use and tailor the Moodle software to user's respective needs. Subjected under the terms of the open source software, the users must agree to provide the following conditions; (i) to provide the source to other users, (ii) not to modify or remove the original license agreement and copyrights and, (iii) to apply this same license to any derivative works (Perens, 1997). The Moodle software is designed to operate on PHP scripts, MySQL database and Apache web server, which can be obtained for free. Hence, Moodle can run on almost all operating systems, such as Windows, Unix, Linux and Mac-OS (de Zwart, 2003). The Moodle installation itself occupies about 11MB of disk space (including all the languages) (de Zwart, 2003). Moodle is designed to assist educators to create a

quality online content and a collaborative, interactive environment to support their classroom courses. Cornell College (2003) further points out some of the advantageous aspects of Moodle; (i) suitable to complement a face-to-face approach in-class teaching and learning process, (ii) simple, efficient and compatible, low-tech browser interface, (iii) encourages a social constructivist pedagogy approach with emphasis on collaboration, activities and critical reflection, (iv) course listing shows descriptions for every course on the server, including accessibility to guests, (v) emphasis on strong security, such as, forms are all checked, data validated and cookies encrypted, and (vi) one Moodle site is able to support thousands of courses.

Prior to preference of the Moodle software in this study, several other softwares were identified and weighed of is pros and cons. However, some prerequisites were lined up given the circumstances of the study. First, the study was conducted on a self-financed basis. Thus, marginalizing the financial gap will prove to be a huge advantage for the study. Second, the development and implementation of the online discussion platform was aimed to be completed within at least a twelve months time frame. Hence, it is imperative to the study for whichever learning management system adopted has to be tailored to the needs of the study with ease. Third, it is paramount that the learning management system under consideration was able to accommodate for constructivist learning environment. The reason is that constructivist learning environment possesses the capacity to regulate balance between the use of technology and pedagogical concerns, without compromising optimal participation from students, or to overwhelm the role of teachers. This is parallel to the objective of the study. That is, to measure the

effectiveness of the *i*ELC discussion platform in advancing better practice of self-regulated learning strategies.

Preference of any learning management system taken into account must be underlined by these key guidelines of the study. It is apparent that commercial learning management systems were not very useful given the financial considerations of the study. Hence, the open source Moodle software was opted for. In addition to cost-effective software, Moodle also provides strong community support for the teachers and researchers in terms of technical and pedagogical support.

In addition to the above, in the process of using the Moodle software in the Cornell campus (http://www.cornellcollege.edu/moodle/), the following advantages of Moodle as an LMS is also emphasized (Cornell College, 2003); (i) a teacher provided with full access has full control over all settings for a course, which includes restricting other teachers, , (ii) courses can be categorized and searched, (iii) choice of course formats such as by week, by topic or a discussion focused social format, (iv) flexible array of course activities, such as, forums, quizzes, journals, resources, choices, surveys, assignments, chats and workshops, (v) full user logging and tracking- activity reports for each student is available with graphs and details about each module (last access, number of times read), (vi) a detailed description of each student involvement such as postings and journal entries, (vii) recent changes to a course since the last login can be displayed on the course homepage, which provides a sense of community, (viii) mail integration- copies of forum posts and teachers feedback can be mailed in html or plain text to the

user, (ix) custom scales- teachers can define their own scales to be used for grading forums, assignments and journals, and (x) courses can be packaged as a single zip file using the Backup function, which can be restored to any Moodle server.

Moodle first appeared in the public domain in August 2002 (Cornell College, 2003). In 2003, the company Moodle.com was initiated in an effort to provide additional commercial support through managed hosting, consulting and other services (Moodle, 2003). Ever since, the Moodle software has been further developed to accommodate a larger population of users in various teaching situations such as Universities, high schools, primary schools, non-profit organizations, private companies and also by independent teachers (Dougiamas, 1999). The Moodle software is designed to advocate a student-centered learning approach in an online learning environment (Moodle, 2003). This is achieved with the practice of the learning activity modules to provoke the learning inquisitiveness in students to further their learning process in an online learning environment.

Moodle (2003) asserts that the use of the Internet allows the student to engage more readily in the learning process and to learn more effectively. Moodle (2003) also states that optimal use of the learning activity modules is able to complement face-to-face teaching and learning. The reason is being that these learning activity modules were designed to the constructivism approach in effort to instigate and promote optimal students' participation in the learning process. Dougiamas and Taylor (2003) points out that constructivism is the most prevalent theoretical perspectives in online learning.

The following is a brief description of the learning activity modules that were available in Moodle. A typical learning process may encompass the combination of two or more modules simultaneously. The forum module acts as a threaded discussion board for asynchronous message exchange between groups of forum members or on a shared subject matter. Discussions in a forum were usually initiated by the teacher, and the other members of the course may contribute to the forum discussions through posts of existing discussion, answering previous posts or by creating new discussions. Forum discussions complement online courses where the focus of the teaching and learning process lies between the students and the shared creation of knowledge (de Zwart, 2003). Posts to the forums will initiate an email message to be sent to other members who subscribe to the forum. This email provides hyperlinks for subscribers to either contribute to the discussion or to unsubscribe from the forum. Conclusively, participation in forum discussions is an integral part of online learning experience, guiding students to define, comprehend and evolve their understanding on a subject matter (de Zwart, 2003).

The Chat module is used for real-time synchronous communication by learners between learners. For a more user-friendly approach, the chat module is able to include profile pictures in the chat window, and is also able to support URLs, smilies, embedded HTML and images. In addition, all sessions were logged for later viewing, and these chat sessions can also be made available to other students or members of a course on preference of the subscriber. The Dialogue module is used for one-to-one asynchronous

message exchange between the instructor and the learner or, between one learner and another.

As a conclusion, this topic discussed on what Moodle is and it came to be. The topic continues to describe the advantages of Moodle as open source software and how it can accommodate student-centered learning approach in classrooms. Several types of modules in Moodle like the forum, chat and dialogue modules were also described briefly.

2.8 Self-Regulated Learning

Bidjerano (2005) asserts that in recent years, self-regulated learning has taken an acknowledged standpoint in education and educational psychology. In the past several years, the focal point of research interest lies in providing a comprehensive appreciation of self-regulated learning in some of the following spectrum of research; gender studies (Bidjerano, 2005), information literacy (Rogers & Swan, 2004), learning (Whipp & Chiarelli, 2004), motivational aspect of self-regulated learning (Chang, 2005), personal epistemologies (Hofer & Pintrich, 2002, 1997), instructional strategies to instigate and foster self-regulated learning (Butler & Winne, 1995), social acceptance of self-regulated learning (Pressley, 1995), developmental changes in self-regulated learning (Paris & Newman, 1990) and, acknowledging the learning theoretical standpoint of self-regulated learning (Paris & Byrnes, 1989).

The teaching and learning process has gained ascendancy over the spectrum of self-regulated learning researches with respect to, among some, academic achievement (Elias & Loomis, 2000; Schapiro & Livingston, 2000; Pajares, 1996), computer-assisted learning (Azevedo, Cromley & Seibert, 2004; Winne & Stockley, 1998), higher education (Kreber, Castleden, Erfani & Wright, 2005; Pintrich, 2004), learning disabilities (Chalk, Hagan-Burke & Burke, 2005; Ruban, McCoach, McGuire & Reis, 2003), motivational aspect (Wolters, 2003), student-teacher interaction (Eshel & Kohavi, 2003), and teacher training (Randi, 2004).

For instance, the study by Schapiro and Livingston (2000) which explored on an extended conception of self-regulated learning discovered that practice of self-regulated learning reflect on qualities such as curiosity, enthusiasm, willingness to take risks and persistent. Another study by Azevedo et al. (2004) which involved 131 undergraduate investigated the effectiveness of self-regulated learning in facilitating students' learning with hypermedia. Students were randomly assigned to a training condition in which they were given a 30 minute training session on using specific self-regulated learning strategies to encourage their conceptual understanding, and to a control condition in which the students received no training. The study discovered that effective practice of self-regulated learning was able to significantly facilitate the students' learning process.

The key factor determining the dominance of self-regulated learning research in the teaching and learning process is because of its renowned characteristics as predictors to

success. That is, students who were skilled in self-regulated learning were also expected to be effective and successful learners (Garcia & Pintrich, 1994; Schunk & Zimmerman, 1994; Zimmerman, Greenberg & Weinstein, 1994; Mithaug, 1993; Newman, 1991; Zimmerman, 1989; Zimmerman & Schunk, 1989). This is largely because successful group of students who excel in academic were those who possess the propensity to self-regulate their approach to learn (Schapiro & Livingston, 2000). Also, self-regulated learning aids in problem solving skills (Winne, 1997) and academic achievement (Murray, 2000; Corno, 1989, 1986).

Hence, it is appropriate to make a claim that self-regulated learning is an important psychological construct in educational research (Ng, 2005). Thus, Boekaerts (1997) notes that a number of educators and policy makers advocate the view that the chief purpose of formal education is to instill self-regulatory skills in students because it is essential not only to one's academic success but also to prepare the student after the schooling years. Ng (2005) establishes that researches on self-regulated learning were in fact a result of understanding students' learning processes. Therefore, given the fact that self-regulated learning is an integrated element with influence on the components of the teaching and learning process, self-regulated learning is defined across a broad spectrum of education. Normally, self-regulated learners were perceived as active learners who were able to efficiently manage their individual learning processes (Perry, 2002; Paris & Paris, 2001; Winne, 2001; Zimmerman & Schunk, 2001; Boekaerts, Pintrich & Zeidner, 2000; Winne & Perry, 2000; Butler, 1998).

Santrock (2001) asserts that self-regulatory learning involves self-generation and self-monitoring of thoughts, feelings and behaviors in order to reach a goal. Cleary and Zimmerman (2004) indicated that self-regulated learners were proactive learners who assimilate several self-regulatory processes with task strategies and self-motivational beliefs. For instance, self-regulation processes include goal setting, self-observation and self-evaluation while task strategies include study, time management and organizational strategies, and self-motivational beliefs include self-efficacy and intrinsic interest. In other words, learners should self-regulate their approach to learning to a level that they are cognitively, behaviorally and motivationally active in their learning process (Zimmerman, 2001).

In a thought provoking paper, Winne (1997) presents how one may develop new forms of self-regulatory strategies and how these strategies are inherent to one's learning. That is, learners must possess the capacity to autonomously deploy one or more self-regulatory measures in an effort to monitor their learning process, and ensure that the stated learning goals are within reach. In addition, self-regulated learning strategies allow students to actively process information giving way to their mastery of the material (Murray, 2000). A self-regulated learner will also be able to develop the knowledge, skills and attitudes to transfer their learning to other situations, with the purpose to facilitate and enhance future learning.

In a conclusion, this topic reviews literature in the subject of self-regulated learning, including the definition of self-regulated learning, strategies of self-regulated learning

and the significance of effective practice of self-regulated learning in the teaching and learning process.

2.9 Motivated Strategies for Learning Questionnaire (MSLQ)

Sungur and Tekkaya (2006) points out that the basis for the understanding of the psychological spectrum of learning has shifted progressively from a teacher-centered teaching approach to that of a student-centered learning approach, bringing about an increased responsibility on students to self-regulate their individual learning process. In other words, students should be independent learners (Sungur & Tekkaya, 2006), progressing towards and for academic self-regulation (Ruban, 2003); that is, to self-regulate knowledge as active participants of the learning process, and not depend on the teacher to acquire knowledge. Previous researches establish that findings on beliefs and cognition which enable students to become independent learners are highly related to academic learning (Sungur & Tekkaya, 2006). Zimmerman (1989, 1998a, 1998b) asserts academic self-regulation as the process by which students are able to activate and continue the process of cognition, affects and behaviors to achieve the acknowledged academic goals.

This viewpoint on the students' capacity as motivated independent learners in a student-centered learning approach has brought about an increased emphasis on classroom teaching and learning process, and other related context as influential factors in student

learning and motivation (Sungur & Tekkaya, 2006). Hence, the educational system has come to appreciate the need for, and association between cognition and motivation in self-regulated learning strategies. That is, when students are motivated, aware of, and are able to reason, the learning process, they are more likely to achieve academic success. Given the importance on motivation and self-regulated learning strategies in the learning process, this research has taken the effort to deliberately measure the cognition and motivation components with hope to improve the teaching and learning process.

Pintrich (1999) establishes the fact that an important aspect of most self-regulated learning model is the use various motivation, cognitive and metacognitive strategies to control and regulate one's learning process. Thus, a presentation of a general framework is much needed to better understand the relationship between components of motivation and components of cognitive and metacognitive strategies in the self-regulated learning process to learning (Pintrich, 1999). However, there are various other models derived from numerous theoretical perspectives (Schunk & Zimmerman, 1994; Zimmerman & Schunk, 1989). Therefore, in effort to narrow the perspective of self-regulated learning to a single spectrum, the researcher chooses to account the basis of self-regulated learning from the works of Paul Pintrich.

Pintrich has successfully established an interaction between motivation and cognition (Duncan & McKeachie, 2005), emphasizing on the importance of motivation-cognition elements in student performance and in lifelong learning (Zusho, Pintrich, & Coppola, 2003; Pintrich, 2003, 2000, 1989; Harackiewicz, Barron, Pintrich, Elliot, & Thrash 2002; Linnenbrink & Pintrich, 2002; Pintrich & De Groot, 1990). This interplay on "cold"

cognition and “hot” motivation is addressed as the key element of his contribution to the field of educational psychology (Duncan & McKeachie, 2005).

The use of the MSLQ instrument is favored in this research due to several reasons. Firstly, the development of the MSLQ instrument is based on the social-cognitive view of motivation and learning strategies; that is, the student signifying an active processor of information whose beliefs and cognition mediated vital instructional input and task characteristics (Duncan & McKeachie, 2005). In the context of this research, this implies that each student exposed to the community learning approach is able to mediate important instructional input and task characteristics, and all the while actively processing information to achieve these instructional input and task characteristics. Secondly, the social-cognitive theoretical framework of the MSLQ instrument is based on the assumption that the motivational elements and the learning strategies are not traits inherent of the student (Duncan & McKeachie, 2005). This indicated that motivational elements and learning strategies are dynamic, self-triggered facets of the learning process that can be learned and controlled by the student. Thirdly, the MSLQ instrument is specifically designed to reflect on the roles of motivation and cognition in the classroom level (Duncan & McKeachie, 2005). In addition, the MSLQ instrument can be used for evaluative purposes (Duncan & McKeachie, 2005). That is, the findings of this research can be extrapolated to a more massive expansion of the research to gather feedback on the effectiveness of the learning process of the students as well as to guide decisions on Form Four Physics KBSM subject assessment.

Furthermore, the MSLQ instrument is frequently used to assess the motivational and cognitive effects across a breadth and depth of different spectrums of instruction (Duncan & McKeachie, 2005). This includes, among some, (i) instructional strategies like the constructivist approach (Hargis, 2001), cooperative learning and peer orientation (Hancock, 2004), students' help seeking strategies (Karabenick, 2004) and, use of goal structures and goal orientations (Wolters, 2004); (ii) content domains like high school social studies (Brookhart & Durkin, 2003), undergraduate chemistry (Zusho, Pintrich, & Coppola, 2003), undergraduate statistics (Bandalos, Finney & Geske, 2003) and, middle school physical education (Ommundsen, 2003) and; (iii) educational technology like enhancing cognitive skills through multimedia designs (Liu, 2003), video conferencing (Siebert, 2002) and, computer-based instruction (Niemi, Nevgi, & Virtanen, 2003; Hancock, Bray, & Nason, 2002; Miltiadou, 2001; Hargis, 2001; Eom & Reiser, 2000; McManus, 2000).

Finally, the MSLQ instrument has proven to be reliable and valuable tool (Duncan & McKeachie, 2005) and has been determined of its reliability and validity in other languages, namely Chinese (Sachs, Law & Chan, 2001) and Spanish (Roces, Tourón, & Gonzalez, 1995). Also, the MSLQ instrument has been translated to various other languages and be utilized in various other countries, among some, Argentina, Australia, Brazil, Canada, Chile, China, Croatia, Cyprus, Egypt, India, Iraq, Japan, Malaysia, the Philippines, Russia, Turkey, the United Kingdom and the United States (Duncan & McKeachie, 2005).

On the whole, the integration of both motivational components and cognitive components of learning is important to appreciate models on self-regulated learning (Garcia & Pintrich, 1994; Pintrich, 1994; Pintrich & Schrauben, 1992). With emphasis on this, this research utilized the Motivated Strategies for Learning Questionnaire (MSLQ) instrument for measuring the level of cognition and motivation for the experimental samples of this research. Hence, the following discussion will bring to light the motivational and learning strategies components of self-regulated learning as developed in the MSLQ instrument.

The Motivated Strategies for Learning Questionnaire (MSLQ) is a self-report instrument designed to measure motivational orientations and their use of different and various learning strategies (Pintrich, Smith, Garcia & McKeachie, 1991). The MSLQ instrument comprises of essentially two sections; a motivation section and a learning strategy section. The motivation section consists of 31 items that is designed to measure the students' goals and value beliefs for a course, their beliefs regarding their skills to succeed in a course, and their level of anxiety about tests in a course (Duncan & McKeachie, 2005; Pintrich, Smith, Garcia & McKeachie, 1991). The learning strategy section also comprises of 31 items, assessing the students' use of different cognitive and metacognitive strategies and, in addition, 19 items, assessing students' management of different resources (Duncan & McKeachie, 2005; Pintrich, Smith, Garcia & McKeachie, 1991). The pre-MSLQ instrument varied in length from 50-140 items during the period of 1982 to 1986 (Duncan & McKeachie, 2005). The 1991 final version of the MSLQ instrument consists of 81 items (Pintrich, Smith, Garcia & McKeachie, 1991).

The items are scored on a 7-point Likert-type scale, ranging from 1 (not at all true of me) to 7 (very true of me). There are a total of 15 scales and can be used together or singly. Table 2.1 illustrates the total initial subscales for the MSLQ instrument. However, there are no norms developed for the MSLQ instrument given the fact that the MSLQ instrument was designed to be used at the course level (Duncan & McKeachie, 2005). This is because the constructivist, social-cognitive model underlying the theoretical framework for the MSLQ instrument assumes that students' responses to the items may vary as a function of different courses (Duncan & McKeachie, 2005). That is, the same individual student might report different level of motivation and/ or learning strategies used, depending on the course. Nevertheless, local norms can be developed for particular courses or subjects for particular institutions if norms for comparisons are desired (Duncan & McKeachie, 2005).

Table 2.1: Initial subscales of the MSLQ instrument

Scale	**Subscales**
Motivation Beliefs	Intrinsic Goal Orientation
	Extrinsic Goal Orientation
	Task Value
	Control of Learning Beliefs
	Self-Efficacy for Learning and Performance
	Test Anxiety
Learning Strategies	Rehearsal
	Elaboration
	Organization
	Critical Thinking
	Metacognitive Self-Regulation

	Time and Study Environment Management
	Effort Regulation
	Peer Learning
	Help Seeking

Adapted from Pintrich et al. (1991)

2.9.1 Motivation Scale

There are 31 items in a total of six subscales in the Motivation Scale of the MSLQ instrument. These six subscales are designed to assess; (i) the students' goals and value beliefs; (ii) the students' beliefs about their ability to succeed and, (iii) the students' anxiety about tests (Sungur & Tekkaya, 2006). These six motivation subscales are segregated into three broad perspectives which consist of value components, expectancy components and affect components (Sungur & Tekkaya, 2006; Pintrich, Smith, Garcia & McKeachie, 1991).

The value component refers to the reasons as to why students engage in a particular academic task (Sungur & Tekkaya, 2006). The value component consists of three subscales to measure value beliefs; intrinsic goal orientation, extrinsic goal orientation and task value. The expectancy component focuses on students' beliefs that they are able to accomplish a task, and is constructed of two subscales which are control of learning beliefs and self-efficacy for learning and performance (Sungur & Tekkaya, 2006). The affect component concerns the student's apprehension and distress over taking examinations, and consists of only one subscale which is the test anxiety subscale (Sungur & Tekkaya, 2006).

Generally, goal orientation concerns the student's perception of the reasons why he or she is engaged in a learning task but the goal orientation subscale on the MSLQ instrument refers to the student's goal or orientation to a particular course as a whole (Pintrich, Smith, Garcia & McKeachie, 1991). Intrinsic goal orientation focuses on learning and mastery of the particular course or learning task (Sungur & Tekkaya, 2006). Pintrich, et al. (1991) further states that this degree of engaging in a learning task has to be for reasons such as challenge, curiosity and mastery. That is, intrinsic goal orientation subscale measures a student's desire to acquire knowledge and understanding or a certain skill through the process of engaging in a learning task.

On the other hand, extrinsic goal orientation subscale focuses grades and approval from other subjects (Sungur & Tekkaya, 2006) in the student's surrounding which may include both peers and instructors. That is, the driving factor for the engagement in a learning task is for external reasons such as grades, rewards, performance, evaluation, competition, to prove their abilities to others (Pintrich, Smith, Garcia & McKeachie, 1991), to avoid punishments and to please others (Ng, 2005).

The task value subscale refers to the student's evaluation of how interesting, how important and how useful a particular learning task is (Sungur & Tekkaya, 2006; Pintrich, Smith, Garcia & McKeachie, 1991). That is, this subscale is designed to assess the student's perception of why he or she is engaged in a learning task. Ng (2005) points out that the task value subscale measures the students' perception of task interest, task

importance and task autonomy. Task interest concerns the student's personal interest in the assigned learning task; task importance refers to the students' beliefs in how significant a particular learning task is for them and their future goals and; task autonomy assess the students' beliefs of how much they are in control of decisions in regard of the learning task assigned to them by their teachers. Pintrich, Smith, Garcia & McKeachie (1991) also a state that high task value should lead the students to more involvement in one's learning.

The control of learning beliefs subscale assesses a student's perception of the locus of control for their own individual learning behaviors and outcomes (Ng, 2005). That is to say, control of learning concerns the students' beliefs whether their efforts to learn will result in positive outcomes (Pintrich, Smith, Garcia & McKeachie, 1991). Explicitly, positive learning outcomes are contingent to the student's own effort, on the contrary to external factors such as the teacher (Pintrich et al., 1991). Thus, if a student fails to understand the course material or an assigned learning task, it is because he or she did not try hard enough. On the whole, students are more prone to study more strategically and effectively if they believe that their efforts make a difference in their learning. Hence, the student is more likely to put forth what is required to achieve the desired learning goals (Ng, 2005).

In the MSLQ instrument, the items comprising the self-efficacy for learning and performance subscale measures two aspects of expectancy; (i) expectancy for success and, (ii) self-efficacy. Expectancy for success refers to performance expectations, which

relates specifically o task performance (Pintrich, Smith, Garcia & McKeachie, 1991). Self-efficacy is a self-appraisal of one's capacity to master a learning task, which includes beliefs of one's ability to accomplish an assigned learning task in addition to one's confidence to perform that task (Pintrich et al., 1991). That is, self-efficacy concerns the students' perception of their ability to perform an assigned learning task and their expectations for success (Ng, 2005). Self-efficacy is an important determinant factor to self-regulated learning (Pintrich & DeGroot, 1990; Bandura, 1986; Schunk, 1985). In addition, the subscale also assesses a student's beliefs about their capacity to learn and to manage his or her learning (Ng, 2005).

The test anxiety subscale assesses students' nervous and worried feelings towards taking a test (Ng, 2005) and has been found to be negatively related to expectancies and academic performance (Pintrich, Smith, Garcia & McKeachie, 1991). In the MSLQ instrument, the test anxiety subscale is segregated into two components; (i) cognitive component and, (ii) emotionality component. Pintrich et al., (1991) states that the cognitive component concerns a student's negative thoughts that may cause interference to performance while, the emotionality component concerns the affective and physiological arousal aspect of anxiety. However, preparation in the use of effective learning strategies and test-taking may help to decrease the level of test anxiety (Pintrich et al., 1991).

2.9.2 Learning Strategies Scale

The self-regulated learning model as described by Pintrich and his co-researchers includes three general categories of the Learning Strategies Scale: (i) the cognitive strategy component scale, (ii) the metacognitive strategy component scale and, (iii) resource management strategy component scale (Duncan & McKeachie, 2005; Garcia & Pintrich, 1994; Pintrich, Smith, Garcia & McKeachie, 1991, 1993; Pintrich & De Groot, 1990; Pintrich, 1989). The cognitive strategy component scale consists of rehearsal, elaboration, organization and critical thinking. The metacognitive strategy component scale consists of metacognitive self-regulation which includes the subscales of planning, monitoring and regulating. The resource management strategy component scale consists of time and study environment, effort regulation, peer learning and help seeking.

The rehearsal, elaboration and organizational strategies were acknowledged as influential cognitive strategies to determine academic performance in the classroom (McKeachie, Pintrich, Lin & Smith, 1986; Pintrich, 1989; Pintrich & De Groot, 1990). The rehearsal strategy involves simple memory tasks, and the activation of information in working memory rather than acquisition of new information in long-term memory (Pintrich, Smith, Garcia & McKeachie, 1991). This includes, among some, the recall of information, recitation of items from a list, and the saying of words aloud (Pintrich, 1999). Rehearsal strategies may also require the comprehension of a text (Weinstein & Mayer, 1986) and the drawing of attention to texts in a passive and unreflective manner (Pintrich, 1999). The purpose of this strategy is to aid the students in focusing and selecting important information, although it does not necessarily reflect on deep level of information processing (Pintrich, 1999). That is, the rehearsal strategy channels for

information to be available in the short-term memory (Ng, 2005). In addition, the rehearsal strategy does not construct internal connections among the information, or to integrate the information with previously acquired knowledge (Pintrich, Smith, Garcia & McKeachie, 1991). In other words, the rehearsal strategy is effective for learning discrete information, although it fails to provide the depth of knowledge to understand relationships between ideas (Lynch, 2006).

The elaboration strategy helps with the accumulation of information into long-term memory through construction on internal connections between the items to be learned (Pintrich, Smith, Garcia & McKeachie, 1991). It includes, among some, the creating analogies to help remembering items, paraphrasing and/ or summarizing of text to be learned, the explanation of ideas and texts to be learned to the teacher or another student, generative note-taking by which a student reorganizes and connects ideas in their notes in comparison to passive note-taking (Lynch, 2006; Pintrich, 1999), and to ask and answer a question (Weinstein & Mayer, 1986). The elaboration strategy aids in the process of integrating and connecting new information with previously learned knowledge (Pintrich, Smith, Garcia & McKeachie, 1991). Hence, the elaboration strategy assists in the retention of knowledge in long-term memory by making connections between the information acquired (Ng, 2005).

The organization strategy helps the learner with the selection of appropriate information and building of connections between the information to be learned (Pintrich, Smith, Garcia & McKeachie, 1991). Examples of organizing strategies are selection of main idea

from the learning materials, outlining necessary information in a text or learning material (Pintrich, 1999), clustering of information (Pintrich, Smith, Garcia & McKeachie, 1991), and use of techniques for organization of ideas, such as, sketching a map of important ideas and identifying the prose or expository structures of texts and learning materials (Weinstein & Mayer, 1986). This strategy is an active, effortful attempt (Pintrich, Smith, Garcia & McKeachie, 1991) which has demonstrated empirical results for a deeper understanding of the materials to be learned in contrast to rehearsal strategies (Weinstein & Mayer, 1986). This allows the learner to be more involved in the undertaken tasks, resulting in a better performance (Pintrich, Smith, Garcia & McKeachie, 1991).

The critical thinking strategy refers to the strategy that a students uses to apply previously learned knowledge to new situations (Pintrich, Smith, Garcia & McKeachie, 1991). Critical thinking is the ability to use acquired knowledge in flexible and meaningful ways, through comprehension of the problem, evaluation of evidence and the consideration of various perspectives (Vanderstoep & Pintrich, 2003). In other words, a critical thinker is able to raise a vital question, using relevant information, in a given situation and justify the solution selected from a number of other solutions against relevant criteria and standards. In addition, student discussion with emphasis on problem-solving procedures and methods is able to enhance critical thinking strategy (McKeachie, Pintrich, Lin & Smith, 1986). Mayer and Goodchild (1990) also asserts that critical thinkers acknowledge that there exists numerous ways to comprehend and assess arguments, and not all of these attempts are necessarily successful. Empirical researches

also indicated that critical thinking strategies can be taught (Gadzella, Hartsoe & Harper, 1989; McKeachie, Pintrich & Lin, 1985).

Besides cognitive use of cognitive strategies, students' awareness of metacognitive knowledge and use of the metacognitive strategies prompts important influence on their achievement (Pintrich, 1999). Researches conducted indicated that learning is enhanced when students are more aware of their learning strategies and possess the capacity to regulate those strategies to correspond to the given task demands (Bransford, Brown, and Cocking, 1999; Schneider & Pressley, 1997, Weinstein & Mayer, 1986).

Flavell (1979) points out that there two general aspects of metacognition; (i) knowledge about cognition and, (ii) self-regulation of cognition. Even so, there has been an increase in doubts on the significance of metacognition as a psychological construct (Brown, Bransford, Ferrara & Campione, 1983). This is largely due to confounding issues on the similarity of characteristics between awareness and knowledge of metacognition with the control and self-regulation of metacognition (Brown et al., 1983).

Pintrich, Wolters and Baxter (1999) propose for knowledge of metacognition to be limited to students' knowledge about a person, task and strategy variables. On the other hand, self-regulation of metacognition refers to students' monitoring, controlling and regulating their individual cognitive activities and actual behavior (Pintrich et al., 1999). However, on reaching a consensus on the definition of metacognition, Pintrich, Smith, Garcia and McKeachie (1991) establish the definition of metacognition as the awareness,

knowledge and the control of cognition. Nevertheless, regardless on the definition of metacognition, the development of the MSLQ instrument focused only on the control and self-regulation aspects of metacognition, not the awareness and the knowledge aspect of cognition (Pintrich, Smith, Garcia & McKeachie, 1991). That is, the focus is on the use of strategies that is performed by individuals to plan, monitor and regulate their cognition (Pintrich, 1999).

Metacognitive self-regulatory activities are comprised of three general processes; (i) planning, (ii) monitoring and, (iii) regulating (Pintrich, Smith, Garcia & McKeachie, 1991; Pintrich & De Groot, 1990; Zimmerman & Martinez-Pons, 1988; Corno, 1986). These three types of self-regulatory strategies are highly related conceptually (Pintrich, Wolters & Baxter, 1999).

(i) Planning Activities

The planning activity appears to assist the student to plan the use of their cognitive strategies (Pintrich, Smith, Garcia & McKeachie, 1991). Planning activities include setting goals for studying, skimming a text before reading, generating questions before reading a text or the learning material (Pintrich, 1999) and, to perform a task analysis of the problem addressed in the learning material (Pintrich, Smith, Garcia & McKeachie, 1991). These planning activities has been investigated in various studies of students' learning (Pintrich, 1999). In addition, the planning activities are also able to prepare a student to activate relevant aspects of their prior knowledge in an effort to improve the organization and the

comprehension of the learning material (Pintrich, Smith, Garcia & McKeachie, 1991).

(ii) Monitoring Activities

Pintrich (1999) points out that the process of monitoring one's thinking and academic behavior is imperative to the development of self-regulated learning skills. Monitoring activities allow the student to understand the learning material and is able to assist the student to integrate the acquired knowledge with their prior knowledge (Pintrich, Smith, Garcia & McKeachie, 1991). Monitoring activities include tracking of one's attention during learning process, which may involve the reading of a text or listening to a lecture and, self-testing through the use of questions about the text material to assess for understanding (Pintrich, 1999; Pintrich, Smith, Garcia & McKeachie, 1991), monitoring the comprehension of a text, a lecture or learning material, using test-taking strategies in an examination-like situation such as the monitoring and adjustment of speed to remaining time (Pintrich, 1999). That is, monitoring activities require some goal or criterion as a benchmark to test students of their understanding (Weinstein & Mayer, 1986). This in turn will guide the monitoring process (Pintrich, 1999). In addition, when students monitor their learning process and/ or performance against a predetermined goal or criterion, the monitoring process will suggest a need to improve self-regulatory activities in order to achieve the predetermined goal or criterion (Pintrich, 1999).

(iii) Regulation Activities

Regulation activities are closely related to monitoring activities as these activities will be able to improve the students' learning process by rectifying their studying behavior (Pintrich, 1999). Pintrich, Smith, Garcia and McKeachie (1991) view regulating activities as "fine-tuning and continuous adjustment of one's cognitive activities" (p. 23). Pintrich (1999) goes further to address some examples of monitoring activities that relates closely to regulating activities. For instance, students are suggested to raise questions when reading a text. This is done to monitor their comprehension of the text material. Subsequently, resume the reading and reread a specific portion of the text material for a thorough understanding. Regulatory activities are also put to use when a student slows the pace of their reading when tackling a less familiar or more difficult text material. This aspect of self-regulated learning which encourages monitoring activities in self-paced learning is one of the fundamental features of the smart school system (Vighnarajah, Wong & Kamariah Abu Bakar, 2006; Ng, 2005; Smart School: The Story So Far, 2003). Reviewing aspects of previously learned knowledge, such as notes, lab material, previous exam papers, and, skipping questions and returning to them back later, reflects general self-regulatory strategies. Regulating activities are assumed to improve the performance by guiding and assisting the student to assess and rectify their studying behavior as they proceed on a task (Pintrich, Smith, Garcia & McKeachie, 1991).

Resource management strategies are also noted imperative to the process of self-regulating one's study. By and large, examples of resource management strategies

include the use of help-seeking strategies, the management and regulation of their time, effort, study environment, and other individuals that may pose an influence to the learning process such as teachers and peers (Ryan & Pintrich, 1998; Pintrich, Smith, Garcia & McKeachie, 1991; Zimmerman & Martinez-Pons, 1988; Corno, 1986). Although these resource management strategies are perceived in line with a general adaptive approach to learning (Pintrich, 1999), these strategies are able to assist the students to familiarize their learning to their individual environment (Sternberg, 1985).

The time and study environment strategy refers to the management and regulation of the student's individual time and study environment (Pintrich, Smith, Garcia & McKeachie, 1991). That is, the students must be able to allocate ample time to meet their learning needs and be able to utilize an environment that encourages concentration and productive work (Lynch, 2006). This strategy is an important skill to possess besides the skill to self-regulate one's cognition (Pintrich, 1999). The time management strategy refers to the scheduling, planning and managing of one's study time (Pintrich, Smith, Garcia & McKeachie, 1991). In more specific detail, time management strategies also involves, among some, the setting of realistic goals, setting aside blocks of time to study and the effective use of that reserved study time (Pintrich et al., 1999). The setting aside of blocks of time to study may vary from daily, weekly to monthly scheduling (Pintrich et al., 1999). On the other hand, study environment management refers to the surrounding, in which the student does his or her studying, which may include class work, assignments and other similar learning activities (Pintrich et al., 1999). Pintrich et al. (1999) also

pointed out that this study environment should, ideally, be relatively free of auditory and visual disturbance, quiet and organized.

The effort regulation strategy refers to the student's capacity to self-regulate their effort and attention when faced with distractions and uninteresting tasks (Pintrich et al., 1991). That is, the self-management of effort regulation requires a commitment to achieve one's study goals, regardless of difficulties or distractions. Pintrich et al. (1991) further points out that effort regulation is an important association to academic success because not only it signifies goal commitment, but more importantly it regulates the continued use of learning strategies in one's learning process.

The peer learning strategy refers to having a collaboration and/ or dialogue with peers in effort to assist the student to clarify doubts on learning materials, and to achieve insights that may not have been possible on one's own (Pintrich et al., 1991). For instance, to set time aside for discussion with peers, to put in effort to explain the learning material to a classmate and working with classmates to complete a homework or assignments. Pintrich et al. (1991) accentuates that the peer learning strategy to have a positive effect on achievement.

The help seeking strategy is another facet of the student's learning environment that must be managed to the support of others, which includes both the peers and instructors (Pintrich et al., 1991). That is, students must be able to identify when they don't know something, and must possess the strategy to seek help from peers and/ or instructors to

provide them with some assistance. Pintrich et al. (1991) further points out that a considerable amount of research indicated that peer help, peer tutoring and individual teacher assistance is able to facilitate students' achievement.

2.10 ADDIE Instructional Design Model

The ADDIE Instructional Design model was preferred because it appreciates the basic development phases, which holds true for any e-learning approach (West Virginia University, 2007). These five phases of the ADDIE Instructional Design model are the Analysis, Design, Development, Implementation and Evaluation phases (Grafinger, 1988). Figure 2.1 illustrates the five phases of the ADDIE instructional model.

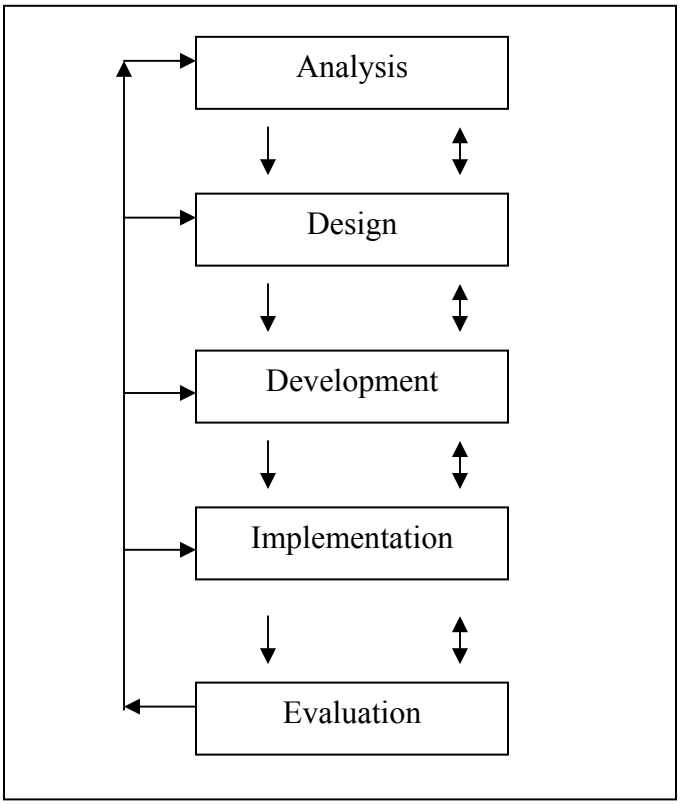

Figure 2.1: The ADDIE Model

Otto (2003) from Cognitive Design Solutions asserts that Instructional Design is a systematic presentation that involves presentations, activities, materials, guidance, feedback and evaluation. That is, the purpose of Instructional Design was to make certain of the effectiveness, efficiency and quality of the instruction addressed. Moreover, Instructional Design allows the author of the learning process, hence the teacher, to take full advantage of the importance of instruction from the learner's perspective (Otto, 2003).

Otto (2003) further points out the brief tasks of each of the phases in the ADDIE Instructional Design model. The Analysis phase included consequential, relevant and achievable instructional objectives to drive the Design phase. The Analysis phase also involved needs analysis to identify the fundamental facets of the entire instructional process. The Design phase, on the other hand, basically underlined the strategies required to realize the instructional objectives identified during the Analysis phase. Thus, the Design phase focused towards selection of content, identification of instructional strategies that were employed and the selection of media and materials that enhanced the instructional process. Subsequently, the Development phase accentuated on the execution of the Design phase to ensure the assimilation of the instructional materials and activities into the Design phase framework. In addition, the Development phase required evaluation at identified intervals of the phase. This was to make certain that the instructional materials and activities selected were able to yield optimal outcome when employed in the teaching and learning process. When the first three phases were in consensus with one another, the instructional design then shifted into the Implementation

phase. That is, this phase looked into carrying out what has been analyzed, designed and developed in the initial three phases of the ADDIE model.

The Implementation phase referred to actual administration of the learning process, all the while emphasizing on the instructional objectives that has been identified. Finally, the instructional design process moves into the Evaluation phase. In this phase, the instructional process was evaluated for its effectiveness in delivering and achieving the identified instructional objectives. The Evaluation phase was divided into a Formative Evaluation phase and Summative Evaluation phase. Formative Evaluation phase looked at evaluation within and between phases, while Summative Evaluation phase looked at evaluation that took place at the end of the instructional process.

In a conclusion, this topic discussed the ADDIE Instructional Design model which consisted of the Analysis, Design, Development, Implementation and Evaluation phases.

2.11 Theoretical Framework

The theoretical framework for this study and subsequently on the development of the proposed *i*ELC discussion platform was constructed on the theoretical dimensions of self-regulated learning, constructivism and Moodle. Figure 2.2 is a graphical representation of the theoretical framework. Self-regulated learning was the variable measured in this study. In the context of this study, self-regulated learning refers to the practice and regulation of the identified motivation and learning strategy components during the learning process of the Form Four Physics KBSM subject. Constructivism was adopted

as the theoretical base in which the teaching and learning process was conducted in both the online and classroom learning environment as proposed by the *i*ELC discussion platform. In the context of this study, the constructive approach in the learning process instigates and encourages students to actively engage in the learning process which leads to student-centred learning. This constructivist approach also encourages teachers to shoulder the roles of facilitators, mediating knowledge and to provide a stimulating environment for optimal learning outcome. Finally, Moodle was the selected as the Tool to design and develop the proposed *i*ELC discussion platform.

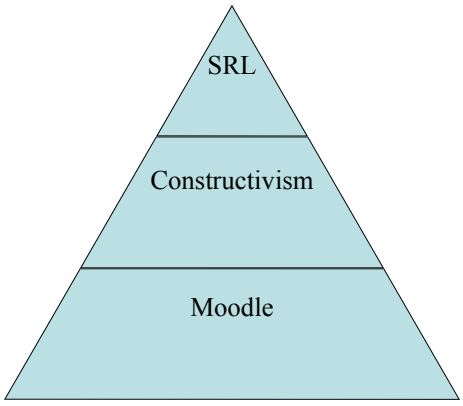

Figure 2.2: Theoretical Framework

2.12 Conceptual Framework

In the context of this study, the conceptual framework of the study offers a graphical presentation on the dependent and independent variables of the study. The dependent variable refers to the variable measured in this study, which was the practice of the self-regulated learning strategies. The independent variable refers to the treatment which will determine the outcome on the measured variable after a defined time period. The

treatment refers to learning through participation in the *i*ELC discussion platform. Figure 2.3 presents the conceptual framework of the study.

2.13 Chapter Conclusion

This chapter outlined the review of literature fundamental to this study. The major review of literature focused on the constructivism theory of learning, which was used as the theoretical groundwork for this study. Discussion was also channeled on the role of teachers as facilitators to the teaching and learning process, which provided an insight on the need to accommodate the teaching and learning environment to foster an active, student-centered learning environment. The chapter discussed the on the advantages of Moodle as open source software. Attention was also highlighted on the conceptual understanding to the practice of self-regulated learning in the teaching and learning process, and subsequently the MSLQ instrument used to measure self-regulated learning. This chapter described the ADDIE Instructional Design model, and finally the theoretical framework and the conceptual framework of the study.

The following chapter will discuss on the project management of the *i*ELC discussion platform. This discussion in based on the ADDIE Instructional Design model with the Analysis, Design, Development, Implementation and Evaluation phases.

CHAPTER 3

PROJECT MANAGEMENT OF THE *i*ELC DISCUSSION PLATFORM

The following sections of the discussion will accentuate on the project management aspect to realize the *i*ELC discussion platform. The ADDIE instructional design model explicated in section 2.10 of Literature Review was used as the framework to manage the *i*ELC discussion platform project, which comprised five key phases namely Analysis, Design, Development, Implementation and Evaluation. The discussion in this chapter begins with a critical point of view on the integration of these five phases into the developmental phases of the *i*ELC discussion platform. This was to ensure that the discussion will provide a multifaceted insight into the significance of the *i*ELC discussion platform in instigating and advancing practice of self-regulated learning strategies in the learning process (refer to Appendix F). Appendix F illustrates the complete operational flowchart which consisted of the analysis, design, development, implementation and evaluation phases. The methodology employed for this study was grounded by a theoretical framework that accentuated on a constructivist learning environment to initiate and sustain student-centered learning process. Moreover, a review of relevant literature identified a comprehensive perception of the problem scenario which led to possible alternatives.

3.1 Analysis Phase

In context of the study, the Analysis phase referred to the process of identifying the necessary factors that determines the running of the *i*ELC discussion platform (refer to Figure 3.1). Hence, the Analysis phase explicated the factors that were taken into account in the process of realizing the *i*ELC discussion platform in the teaching and learning process. These factors were the objective of the *i*ELC discussion platform, the target users, scope of learning, use of the instructional tools, asynchronous and synchronous participation in the *i*ELC discussion platform and the roles of the online course facilitators.

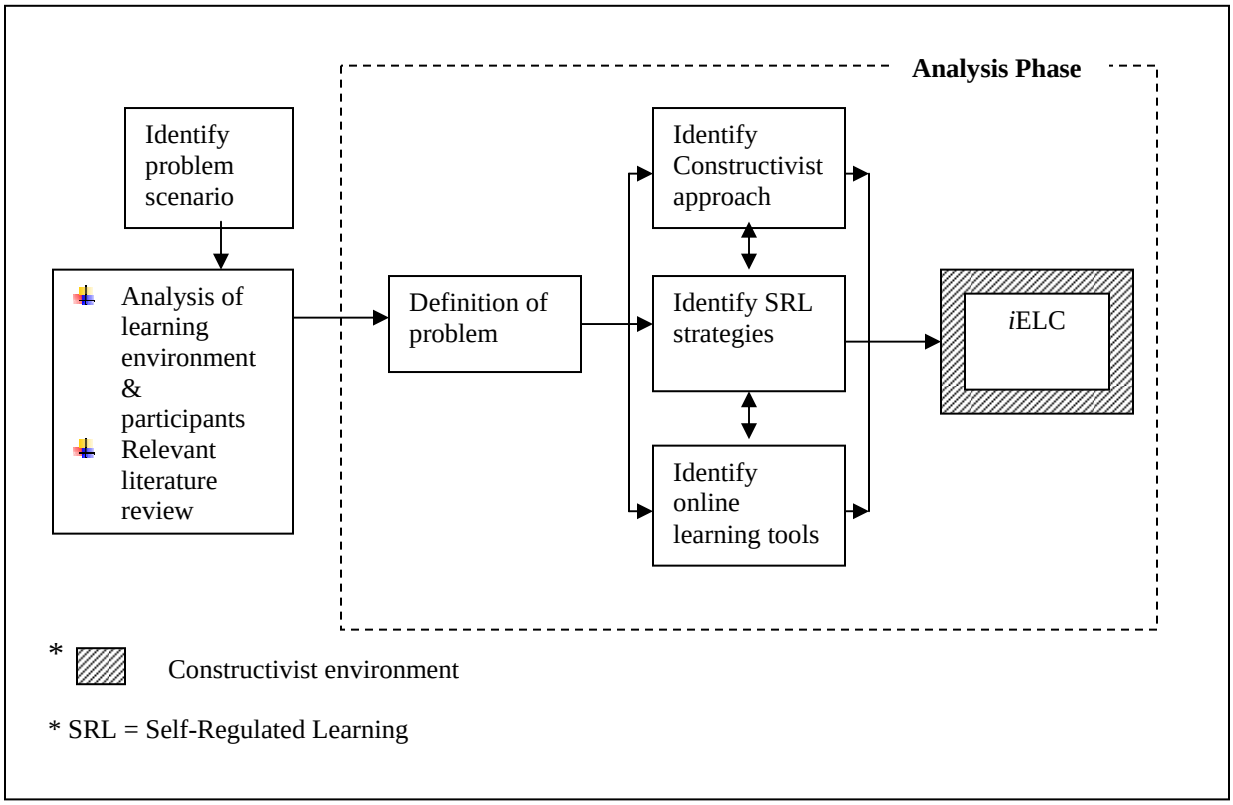

Figure 3.1: The Analysis phase operational flowchart

3.2.1 Objective of the *i*ELC Discussion Platform

Review of literature has clearly pointed out that practice of self-regulated learning was an invaluable asset for effective learning. Undoubtedly, students with good practice of self-regulated learning are able to become more effective and successful in learning (Garcia & Pintrich, 1994; Schunk & Zimmerman, 1994) because these students were able to self-regulate their approach to the learning process (Schapiro & Livingston, 2000) and to practice improved task-engagement and communication among peers (Cavalier, Klein & Cavalier, 1995). Hence, the *i*ELC discussion platform was developed with the aim to instigate and improve practice of self-regulated learning in the learning process.

3.2.2 Target Users

In the context of this study, the target users for the *i*ELC discussion platform were the Form Four Physics KBSM students from the identified experimental regular national secondary schools. At the time of the study, the current number of target users was on the average of 40 students per class, hence, adding up to an average of 80 students per single login into the *i*ELC discussion platform. Large account of students' participation in the *i*ELC discussion platform was necessary to amplify a student-centered learning environment.

3.2.3 Scope of Learning

The scope of learning covered the Form Four Physics KBSM subject in Kuala Lumpur as directed by the Ministry of Education. Particular attention was focused on the learning of Chapter 2: Kinetics and Motion of the Form Four Physics KBSM syllabus. This chapter was deliberately selected because it allowed ample time for students to familiarize with the new Physics subject and was able to effectively practice self-regulated learning

3.2.4 Use of the Instructional Tools

The key approach to the learning process through participation in the *i*ELC discussion platform involved the use of the forum discussion board, chat tool and the dialogue tool. The use of these identified learning tools were deliberately selected due to its advantages in fulfilling the interest of the study, which was to instigate and improve practice of self-regulated learning in a student-centered learning environment.

3.2.5 Asynchronous and Synchronous Participation in the *i*ELC Discussion Platform

In the current interests of the secondary school curriculum, the Form Four Physics KBSM subject was still conducted as a hybrid course. Ko and Rossen (2004) points out that a hybrid course is one that is addressed in both the face-to-face approach and the online approach. That is, participation in the *i*ELC discussion platform complemented the

classroom teaching and learning process. This implied that the traditional teaching and learning method required the presence of the Internet to complement the classroom teaching process, and vice versa.

3.2.6 Online Course Facilitators

Only the researcher and the respective experimental school teachers were acknowledged to moderate the discussion and participation in the *i*ELC discussion platform. First, the identified teachers acted as the online course moderators. These teachers shouldered the role of mediating information between one student and another, contributing to an engaging a student-centered, online learning environment. Second, the researcher also shouldered the role as the online course moderator. This allowed the researcher to acquire qualitative data through means of semi-structured interview with students and the teacher to support the findings of the study on the practice of self-regulated learning. This opportunity allowed the researcher to act as the webmaster, and to report any technical difficulties faced during participation in the *i*ELC discussion platform.

3.3 Design Phase

The Design phase referred to the measures taken to design the teaching and learning process to be addressed by the *i*ELC discussion platform (refer to Figure 3.2). The Design phase underlined some of the facets that distinguished the *i*ELC discussion platform from

other online learning platform available on the Internet, which were to engage in the learning process in a student-centered, constructivist learning environment and, pedagogically sound self-regulated learning enablers. The Design phase explicated the use of the identified learning tools in the *i*ELC discussion platform and its integration with the teaching and learning process to improve practice of self-regulated learning.

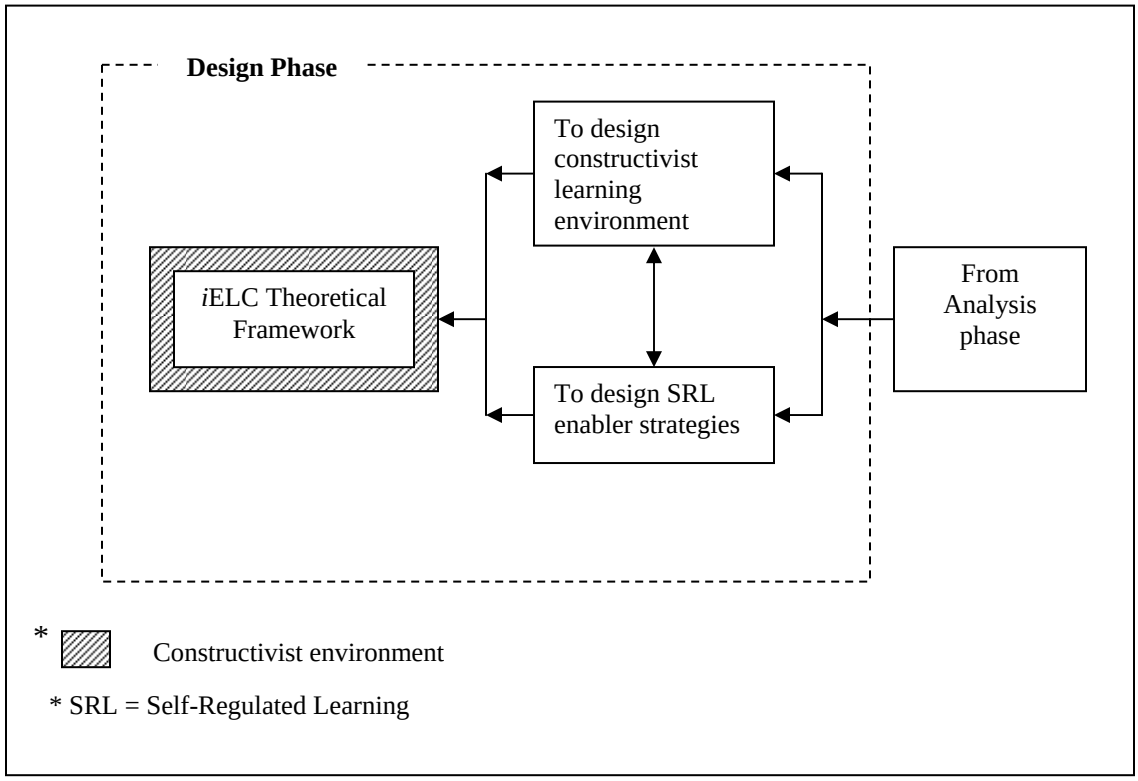

Figure 3.2: The Design phase operational flowchart

3.3.1 Constructivist Learning Environment

The ultimate aim of a constructivist learning environment was to create a student-centered learning environment (Roblyer et al., 1997) and to optimize students'

participation in the learning process (Ormrod, 2000). Students' participation in the *i*ELC discussion platform was specifically aimed to achieve a student-centered learning environment with optimal task-engagement in the teaching and learning process. In the context of this study, the catalyst to initiate and sustain the constructivist learning environment was anticipated through speculation and investigation of instructional problem subsequent to being exposed to only the necessary information. Minimal exposure to necessary information motivated and assisted students to deliberate on the solution or alternation to the assigned instructional problem, allowing for improved practice of self-regulated learning. These instructional problem task-engagement activities were supervised by the students' respective Physics teachers when it was conducted through the classroom teaching and learning process, and supervised by the researcher when similar questions were posted in forum discussion. Supervision on learning activities was necessary since the students were still new to the Form Four Physics KBSM subject. Moreover, the educational system required the Form Four Physics syllabus to be completed in a specified time frame, and thus an entirely unsupervised learning process may cause the syllabus not to be completed within the specified time frame. Hence, providing the students with a partially supervised learning approach allowed students to be in the right track of the learning process, while practicing self-regulated learning.

In the context of participation in the *i*ELC discussion platform and participation in the classroom as underlined by the study, students were directed towards the process of assimilation and accommodation of information. Atherton (2005) asserts that assimilation

and accommodation were adaptation processes that were indivisible and exist in a mutual relationship. Atherton (2005) points out that assimilation was a process that allows for the incorporation of new information into the internal world, without modifying the structure of the internal world. Accommodation, on the other hand, was the process of confronting the pre-existing internal world, and thus adapting and developing a new concept as a result of conflict from the pre-existing internal world (Atherton, 2005).

In the context of this study for instance, the process of assimilation referred to incorporating the understanding and use of individual variables and symbols such as *m* to represent *mass* and *v* to represent *velocity*. The fundamentals of these variables and symbols were acquired in Chapter 1 of the Form Four Physics KBSM syllabus. The process of accommodation referred to applying use of these variables and symbols in novel concepts and to solve instructional problems, such as the multiplication of *mass* (*m*) and *velocity* (*v*) to represent *momentum*.

Tan (2003) points out that to be engaged in a constructivist learning environment fosters the need for activation of prior knowledge (Tan, 2003). This was imperative in encouraging a conducive, constructivist learning environment in which students will be able to harness practice of self-regulated learning.

3.3.2 Student Instructional Activity Module

The Student Instructional Activity Module was aimed to guide students to engage in the constructivist learning environment provided in participation in the *i*ELC discussion platform and in classroom discussion as underlined by the study. Effective use of the Student Instructional Activity Module was also aimed to encourage minimal teacher-centered teaching and optimal student-centered learning.

Normala Othman and Maimunah Abdul Kadir (2004) points out that it was imperative for the teaching and learning process to center on minimal teaching as teachers play the role of facilitator and students to play the role of knowledge seekers. Appendix D illustrates an example of the Student Instructional Activity Module used during participation in the *i*ELC discussion platform and in classroom discussion. The Student Instructional Activity Module comprised several questions that were usually expected of the Form Four Physics KBSM syllabus.

These questions were constructed by the researcher with feedback from Physics teachers regarding students' most common misconceptions on the practice of symbols, formulas, definitions and concepts. It was also important to point out that these questions were designed to conform to the constructivist approach with aim to encourage optimal students' participation in the teaching and learning process.

3.3.3 Self-Regulated Learning Enablers

The following discussion brings to light self-regulated learning enablers identified in this study. In the context of this study, self-regulated learning enablers referred to the instructional tools and activities identified to improve practice of self-regulated learning strategies in the learning process. These identified self-regulated learning enablers were forum discussion sessions, chat sessions, dialogue sessions, classroom discussion and the student instructional activity module. Figure 3.3 illustrates the self-regulated learning and collaborative learning support enablers.

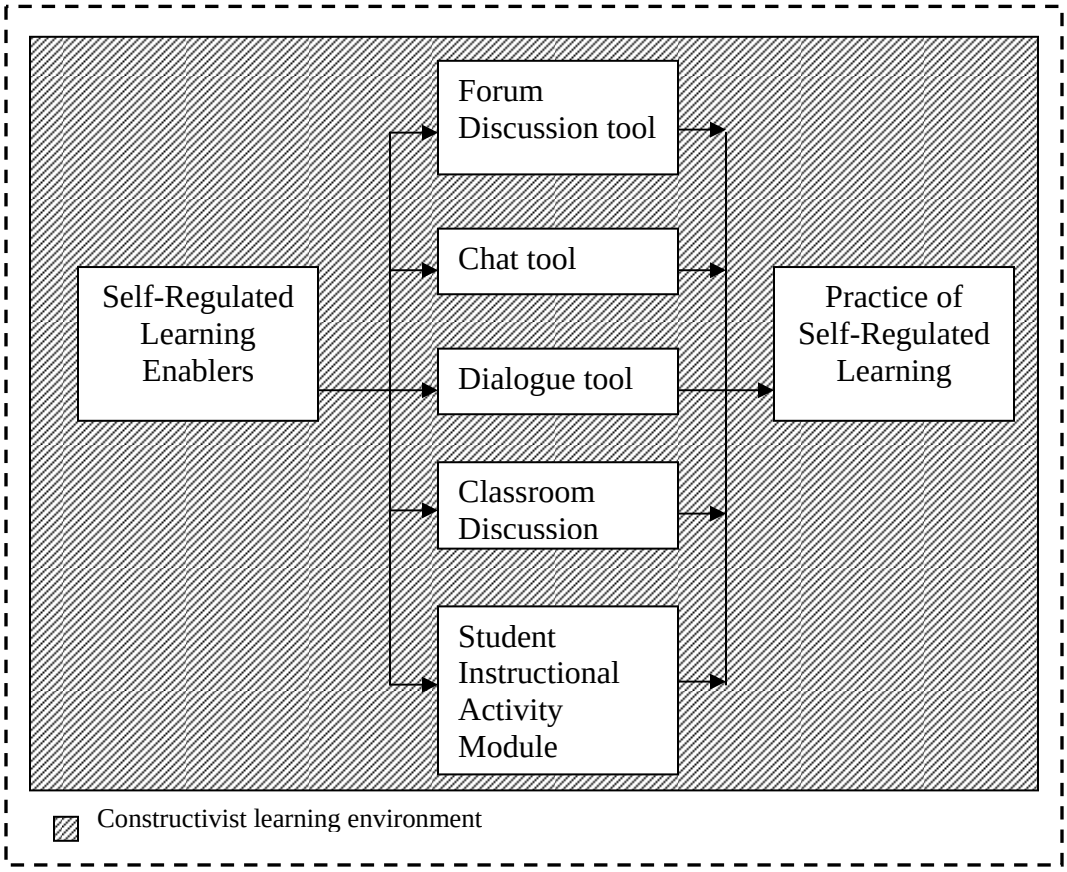

Figure 3.3: Self-regulated learning enablers

Table 3.1 provides a comparison on the definition of self-regulated learning and the suggestions on how self-regulated learning was practiced in the *i*ELC discussion platform and in classroom discussion (refer to Appendix G). To reiterate, the self-regulated learning variable consists of motivation components and learning strategies components. Refer

Table 3.1: Practice of self-regulated learning enablers

<table>
<tr><th>Definition of Self-Regulated Learning</th><th>Suggested Practice of Self-Regulated Learning Strategies in the iELC Discussion Platform</th></tr>
<tr><td colspan="2">Motivation Components</td></tr>
<tr><td>Intrinsic Goal Orientation
Intrinsic goal orientation refers to engaging in learning tasks for reasons such as challenge, curiosity and mastery of knowledge (Pintrich et al., 1991). Intrinsic goal orientation subscale measures a student’s desire to acquire knowledge and understanding.</td><td rowspan="2">To encourage improved practice of the self-efficacy for learning and performance component in the iELC discussion platform, students were exposed to range of instructional problems on an increasing level of difficulty. First, to solve fundamental Physics problems with thorough guidance from teachers. For instance, stating symbols, definitions, formulas and concepts. This was to ensure students possess the proper Physics concepts required to engage in further instructional</td></tr>
<tr><td>Extrinsic Goal Orientation
Extrinsic goal orientation subscale refers to engaging in learning tasks for reasons such as grades, rewards, performance, evaluation, competition, to prove their abilities to others (Pintrich et al., 1991; Sungur & Tekkaya, 2006) to avoid punishments and to please others (Ng, 2005).</td></tr>
</table>

Control of Learning Beliefs The control of learning beliefs subscale assesses a student's perception of the locus of control for their own individual learning behaviors and outcomes (Ng, 2005) and whether their efforts will result in a positive outcome (Pintrich et al., 1991).	problems. Second, to solve Physics problems that require skills in assimilating prior knowledge into these problems. For instance, assimilating definitions of *velocity* (meter/ second) and *mass* (*kilogram*) into solving momentum related problems. Solving these problems concerns the use of lower order thinking skills on the Bloom's Taxonomy. Finally, to solve Physics problem that requires skills to assimilate prior knowledge and accommodate it to novel situations. For instance, to integrate momentum concept to solve inertia related problems. Solving these problems concerns the use of higher order thinking skills on the Bloom's Taxonomy.
Self-Efficacy For Learning And Performance The self-efficacy for learning and performance construct measures expectancy for success and self-efficacy. The former strategy assesses task performance and the latter strategy assesses one's perception on the ability of accomplishing an assigned learning task (Pintrich et al., 1991).	

Learning Strategies Components	
Rehearsal The rehearsal construct refers to the recall of information, and recitation of information, of which the primary purpose of these tasks was to assist in the selection of important information and the activation of information in the working memory (Pintrich, 1999;	By engaging in the *i*ELC learning tools and activities, the students were required to perform the rehearsal strategy through some of the following learning tasks in the Physics

Pintrich et al., 1991).	subject; for instance, (i) stating the definition of terms such as displacement, acceleration, velocity, etc., (ii) stating the units of measurements such as length, mass, time, volume, (iii) stating the equations of motions, and (iv) stating the Newtonian laws of motion.
Elaboration The elaboration strategy accounts for retention of knowledge in long-term memory, establishing connection between prior knowledge acquired to the knowledge to be learned (Ng, 2005; Pintrich et al., 1991). Examples of elaboration strategies were summarizing the text to be learned to teachers and other students, reorganizing and connecting ideas in generative note-taking, and asking and answering questions (Lynch, 2006; Weinstein & Mayer, 1986).	Through means of *i*ELC learning tools and activities, students were encouraged to actively engage in the elaboration strategy through some of the following learning tasks; for instance, (i) To relate the principle on the conservation of momentum to an everyday situation, (ii) To apply the equations of motion to determine the answer to a single variable, (iii) To compare and contrast the relationship between force and extension of a spring, and (iv) To explain with examples on the relationship between inertia and mass.
Organization The organization construct refers to the	In the context of the study, it has

strategy used to select the necessary information from the learning materials and making connections between the information to be learned (Pintrich et a., 1991; Weinstein & Mayer, 1986). Examples include deciding on key concepts of a learning text and clustering of information, and allowing for a deeper understanding of the materials to be learned (Pintrich, 1999; Pintrich et al., 1991).	to be acknowledged that the *i*ELC teaching and learning approach was not specifically designed to harness this strategy on organization. However, the *i*ELC teaching and learning approach did possess the potential to channel students towards the acquisition of the organization strategy, by actively involving in learning activities using *i*ELC learning tools.
Critical Thinking The critical thinking strategy accounts for the ability to apply knowledge in meaningful ways through understanding of the instructional problem, and to evaluate evidence through consideration of various perspectives (Vanderstoep & Pintrich, 2003). It was also important to note that learning activities with problem-solving procedures was able to enhance critical thinking strategy (McKeachie, Pintrich, Lin & Smith, 1986).	With aid from the *i*ELC learning tools and activities, it was evident that Physics subject learning tasks possess the potential to heighten the critical thinking strategy. For instance, to critically practice the use, and integration, of prior knowledge and the newly acquired knowledge to justify solutions or alternatives to a learning task, (ii) to encourage student to post key questions and provide effective answers in classroom discussion and in *i*ELC forum discussions, and (iii) to critically perceive the integration of Physics in their

	respective surrounding and, in technology and society.
Metacognitive Self-Regulation The metacognitive-self-regulation strategy consists of planning, monitoring and regulating (Pintrich et al., 1991). Planning activities prepares the student to activate their prior knowledge to lead to the comprehension of a learning material (Pintrich et al., 1991). Monitoring activity requires the student to benchmark their comprehension of a learning material, or use of prior knowledge into the learning process (Pintrich et al., 1991; Weinstein & Mayer, 1986). Finally, regulation activity was closely related to monitoring activity, which was used to improve students learning process by rectifying the study behavior (Pintrich et al., 1991).	Similar to the organization strategy, the *i*ELC teaching and learning approach was not specifically designed to harness the metacognitive self-regulation strategy. However, the *i*ELC teaching and learning approach did possess the potential to channel students towards the acquisition of the metacognitive self-regulation strategy, by actively involving in learning activities using *i*ELC learning tools.
Time And Study Environment On the whole, the time and study environment management strategy accounts for the management and regulation of the student's individual time and study environment (Pintrich et al., 1991). With the *i*ELC teaching and learning process consisting of the classroom discussion approach as well as online learning approach, students were well guided to manage their respective time and study environment.	The measures taken to achieve this was divided into three major aspects; (i) firstly, use of the classroom discussion to manage time and study environment in the school learning process, (ii) secondly, use of the *i*ELC forum discussion, chat and dialogue as asynchronous tool to manage time and study environment after

	schooling hours and, (iii) finally, use of the Student Instructional Activity Module to complement and bridge the classroom discussion approach and the online learning approach. These three measures were imperative to provide a comprehensive understanding in viewing the learning process as a continuous developmental process; an interactive interaction between schools, the environment and the curriculum (Ertmer & Newby, 1993).
Effort Regulation The effort regulation strategy accounts for the self-regulation of the student's effort and attention when faced with distractions and uninteresting tasks (Pintrich et al., 1991). In the context of the study, *i*ELC learning tools and activities put forward the following measures to guide the students to harness strategies on effort regulation. The two primary aspects of effort regulation were to overcome, firstly distractions, and secondly uninteresting tasks. In learning the Physics subject, distractions in the learning process refers to, for instance, difficult topics and unfamiliar Physics terms used, that causes a student from	In effort to overcome distractions in learning Physics, firstly, it was imperative to encourage students to reason the key questions and alternatives in difficult learning tasks. Secondly, students were guided to demonstrate critical thinking in distinguishing and solving learning tasks. In addition to the above measures, the following step that *i*ELC learning tools and activities does in attempt to assist students to overcome uninteresting tasks,

understanding the central problem in the assigned Physics learning task. On the other hand, uninteresting tasks refer to learning tasks, which appear to be boring and tedious, may account to disrupt the learning process.	and ultimately to practice effort regulation strategies, was to present structured learning tasks that students were able to perform with little, or no guidance from teachers and fellow students. The next step was to encourage students to work in small groups to complete learning tasks. Through the participation in classroom discussion and *i*ELC forum discussion, as well as through use of *i*ELC chat and dialogue tools, these measures were able to help students to overcome distractions and uninteresting tasks in learning the Physics subject. Moreover, in attempt to encourage effort regulation strategies, these measures were able to assist students to acquire a perspective on the direction on the Physics learning process, and eventually to prioritize tasks in the learning process.
Peer Learning The peer learning strategy refers to collaborative learning with peers, with aim to clarify doubts on learning materials that may	The *i*ELC learning tools and activities was able to account for the practice of peer learning

not have been possible on one's own (Pintrich et al., 1991).	strategy in the teaching and learning of Physics through some of the following measures; for instance, (i) to engage in collaborative learning tasks with other fellow students through the use of the Student Instructional Activity Module, (ii) Each student was encouraged to assist each other to involve in the learning process through participation in classroom discussion, and (iii) To observe peer learning strategies through participation in *i*ELC forum discussion, chat, dialogue and glossary.
Help Seeking The help seeking strategy describes the situation when a student, knowing when they were unable to comprehend a learning material, was able to seek help from peers and/ or instructors to guide them to understand or solve the instructional problem (Pintrich et al., 1991).	The *i*ELC learning tools and activities effectively addressed this strategy on help seeking by requiring students to engage in some of the following learning tasks; for instance, (i) posting questions in forum discussion to gain insight to the question, (ii) using the *i*ELC chat and dialogue learning tools for a more confidential 'online conversation' with other students

	of the *i*ELC discussion platform, and (iii) participating in classroom discussion to clear doubts and to provide perspective into the discussion.

3.4 Development Phase

The Development phase referred to the measures taken to develop the instructional materials and tools practiced in the *i*ELC discussion platform and in classroom discussion (refer to Figure 3.4). These instructional materials and tools were developed to accommodate the constructivist learning environment, while encouraging improved practice of self-regulated learning. The discussion was basically divided into two major sections of development of instructional tools for the *i*ELC discussion platform and development of instructional materials for classroom discussion. The former section of the discussion included description on the development and use of the forum discussion, dialogue tool and the chat tool, while the latter describes the development of the Student Instructional Activity Module which was utilized only by students in the experimental group.

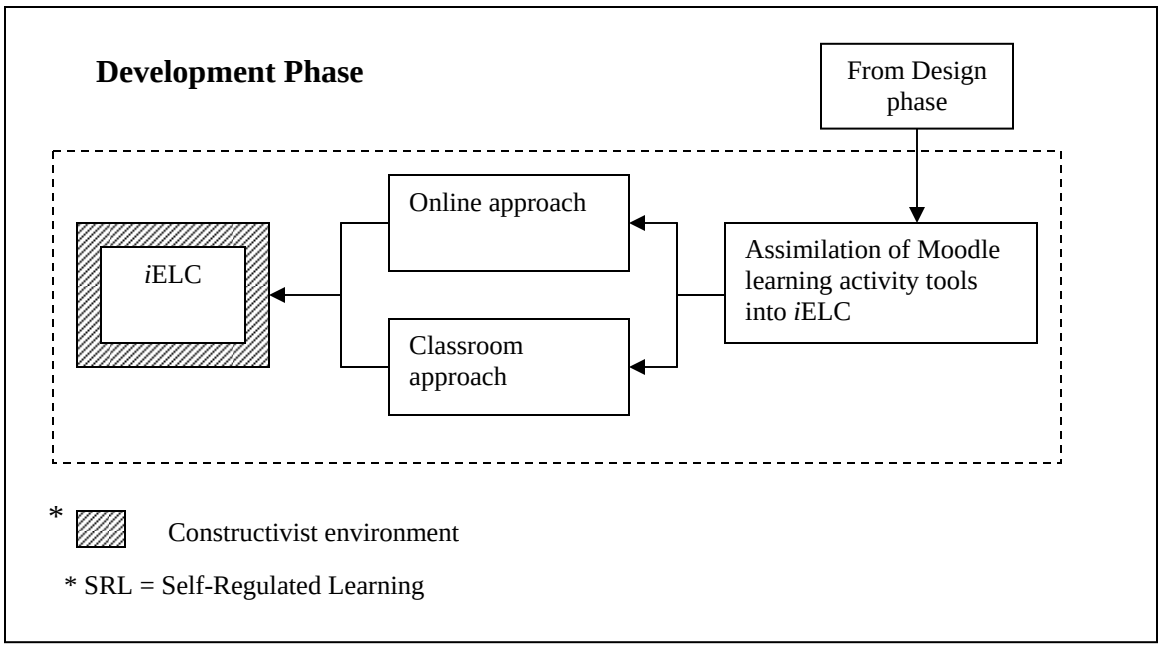

Figure 3.4: The Development phase operational flowchart

3.4.1 Development of Instructional Tools for the *i*ELC Discussion Platform

3.4.1.1 Forum Discussion Tool

In context of the study, the forum discussion tool was an online discussion area that allowed for online sharing of information. Students who participated in the *i*ELC discussion platform used the forum discussion tool to initiate discussion on a topic, and to share information and opinions on a discussion topic. With the *i*ELC discussion platform utilized in asynchronous mode, it was obvious that the forum discussion acted as the primary means of communication between users of the *i*ELC community in the online learning environment.

Asynchronous discussion implied that the students, teachers and the administrator corresponded with each other without simultaneously logging in the *i*ELC discussion platform. Research also points out that students were more prepared to participate in asynchronous forum discussion compared to classroom participation (Moodle, 2003).

The reason was that students might be shy in making mistakes and by participating in the asynchronous mode they were able to ensure their responses before posting it to the forum discussion for others to view (Moodle, 2003). There were two means of posting discussions and replies. Discussion referred to initiating a new topic to be discussed, while replies referred to response to other students' comments in a discussion topic.

Firstly, students were allowed to post both discussions and replies. Secondly, students were not allowed to initiate new discussion topics but were only allowed to reply. This was normally practiced for teacher only forums. Figure 3.5 illustrates the position of the General Forum and the Learning Forum in the *i*ELC discussion platform.

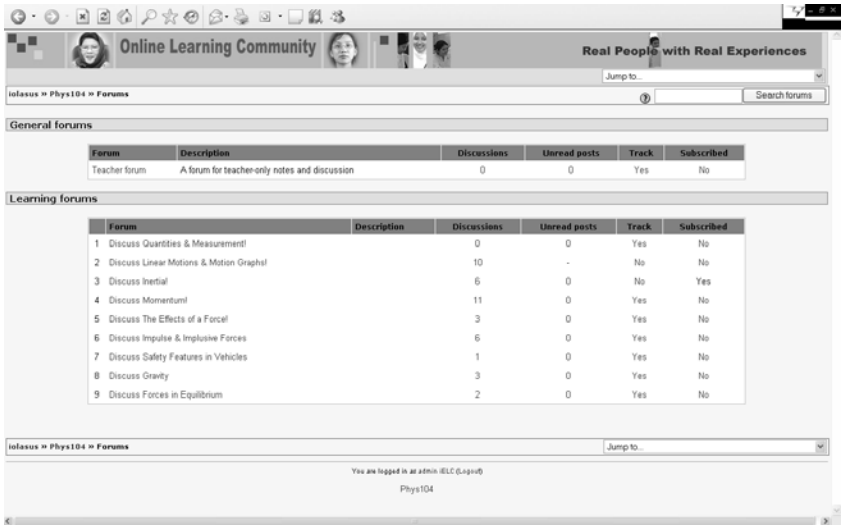

Figure 3.5: General Forum and Learning Forum

3.4.1.1.1 General Forum

The discussion topic initiated under the General Forum was labeled as Site News. For participation in Site News, students were allowed to reply to a discussion topic as posted by the teacher or the administrator of the forum. The discussion topic initiated under the General Forum was aimed to acquire students' opinion over the topic posted in the forum discussions and their perception of participating in the *i*ELC discussion platform, which acted as an ice-breaker for students to familiarize with participating in the *i*ELC discussion platform. The reason the researcher set the Site News where students were not allowed to post new topics but only to reply to topics posted was to avoid overload of other distracting posts by other students. Figure 3.6 illustrates the Site News discussion thread in the *i*ELC discussion platform.

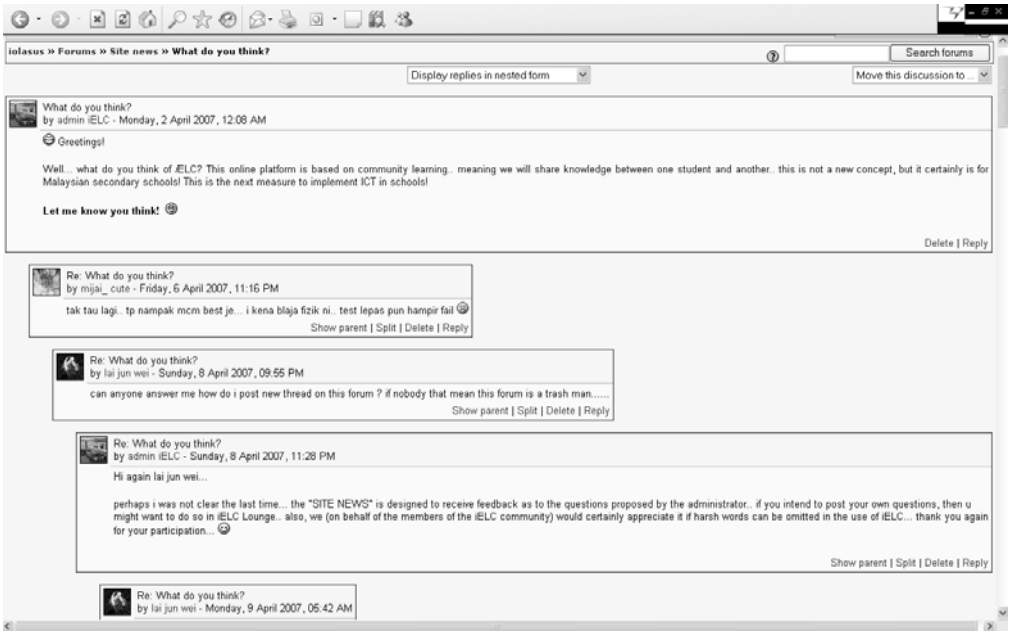

Figure 3.6: Site News discussion thread

The *i*ELC Lounge discussion thread was initiated under the General Forum to allow student to initiate discussion topic, while replying to posts by other students, teachers and the administrator. The purpose of this mode of discussion and replies was to encourage students to address their questions to their peers, teachers and administrator without being restricted to topics. This measure was also aimed to promote practice of self-regulated learning among students participating in the *i*ELC discussion platform. Figure 3.7 illustrates the *i*ELC Lounge discussion thread in the *i*ELC discussion platform.

Figure 3.7: The *i*ELC Lounge discussion thread

3.4.1.1.2 Learning Forum

Similar to the General Forum, the Learning Forum also allowed students to reply to a discussion topic posted by their peers, teachers and the administrator. This mode of forum was preferred in the Learning Forum to encourage student to post questions, as well as to actively reply to posts by other students. As encouraged in the constructivist learning environment, students were encouraged to post discussion topics subsequent to classroom discussion. This measure was taken to ascertain optimal participation in the teaching and learning process. Moreover, continuous practice of discussion between student, through both the classroom and online activities, could improve practice of self-regulated learning. Figure 3.8 illustrates the Learning Forum discussion threads in the *i*ELC discussion platform.

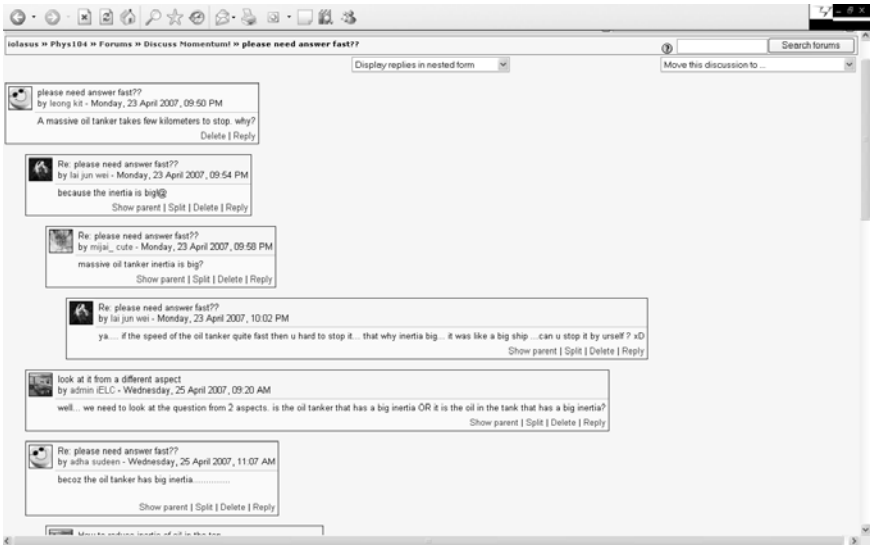

Figure 3.8: Learning Forum discussion threads

Subscription was another advantage on development of the *i*ELC discussion platform. Students may choose to be subscribed to receive email updates on topics and replies posted in forum. This allowed students to keep track on topics and replies posted by other students, and obliges them to participate actively in the learning process. Figure 3.9 illustrates the subscription process to the Learning Forum in the *i*ELC discussion platform.

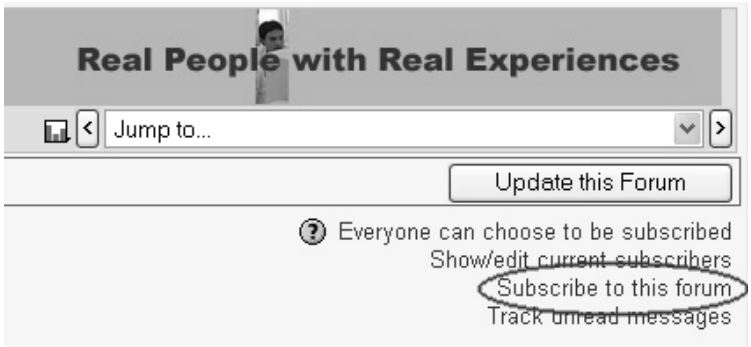

Figure 3.9: Subscription to the Learning Forum

When a topic or reply was posted, a screen would appear notifying that the post (or reply) has been successfully saved and the remaining time left if changes were to be made to the topic (or reply) posted. The default time set was 30 minutes before the topic (or reply) posted were emailed to other students of the *i*ELC community, which were finalized and cannot be edited by the student user. Figure 3.10 illustrates the notification of elapsed time after putting up posts in the *i*ELC forum discussion.

Figure 3.10: Notification of elapsed time

3.4.1.2 Dialogue Tool

Similar to the forum tool, the dialogue tool was also used for asynchronous discussion. In the context of this study, the dialogue tool was used as a form of asynchronous communication between student-teacher, student-administrator, student-student, and teacher-administrator. This tool was also an excellent alternative should the student/ teacher/ administrator wishes to track correspondences between another individual, all in one place (Moodle, 2003). Figure 3.11 illustrates the dialogue tool which was found in the student's profile for easy track of private communication. Figure 3.12 illustrates an example of dialogue message recorded between a student and the administrator.

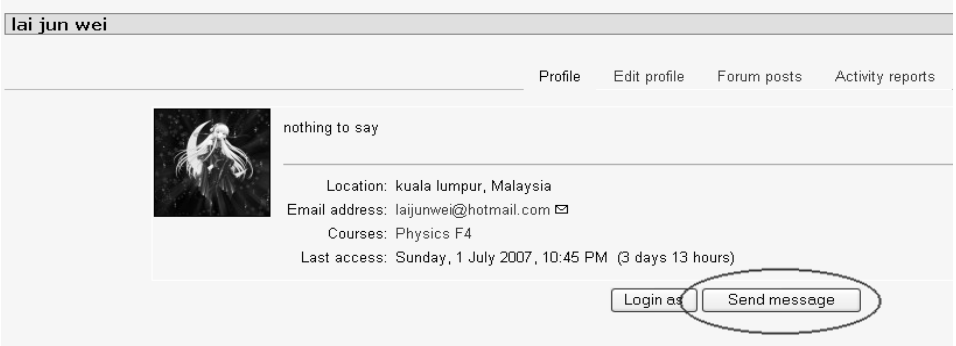

Figure 3.11: The Dialogue tool

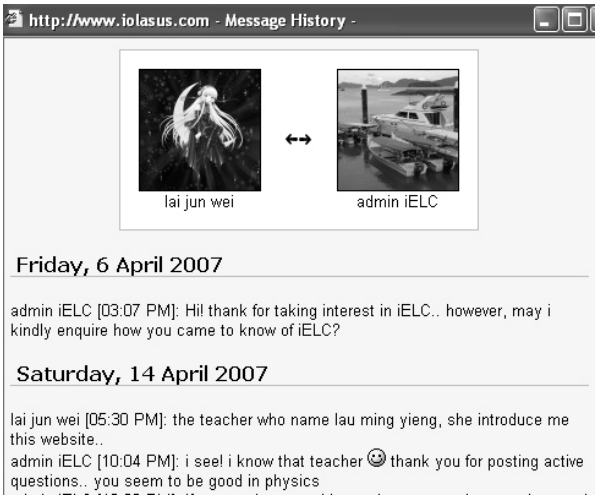

Figure 3.12: Example of dialogue message history

3.4.1.3 Chat Tool

The Chat tool was basically used for synchronous discussion between two or more students. Use of this tool was particularly useful when a synchronous discussion was required on a topic posted in the forum discussion. Figure 3.13 illustrates the Chat Tool interface used in the *i*ELC discussion platform.

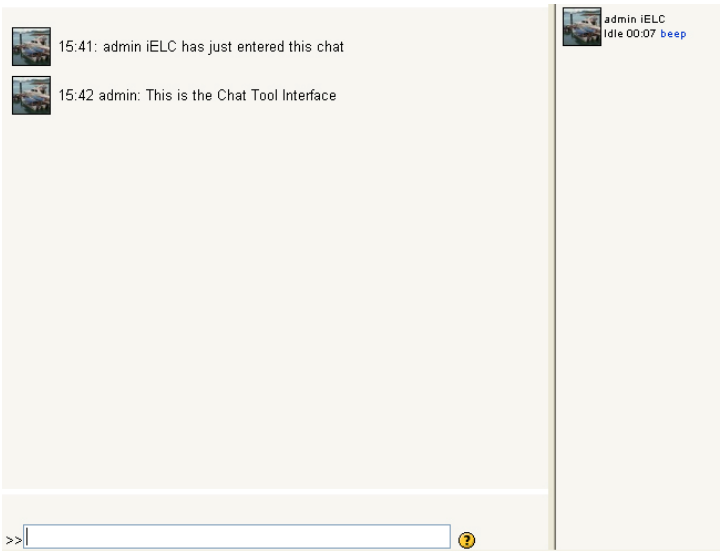

Figure 3.13: Chat Tool interface

3.4.2 Development of the Student Instructional Activity Module

The following discussion draws attention to the development of the Student Instructional Activity Module for use in classroom discussion. This module was designed to accommodate the constructivist learning approach. It was also important to point out that development of this module was designed only to guide students to optimally engage in the teaching and learning process, and not to influence outcome on the practice of self-regulated learning. Figure 3.14 and 3.15 illustrate questions that are found in the Student Instructional Activity Module. Figure 3.14 illustrates questions that were used to guide students' individual participation in the discussion while Figure 3.15 illustrates questions that guide students' group participation in the discussion.

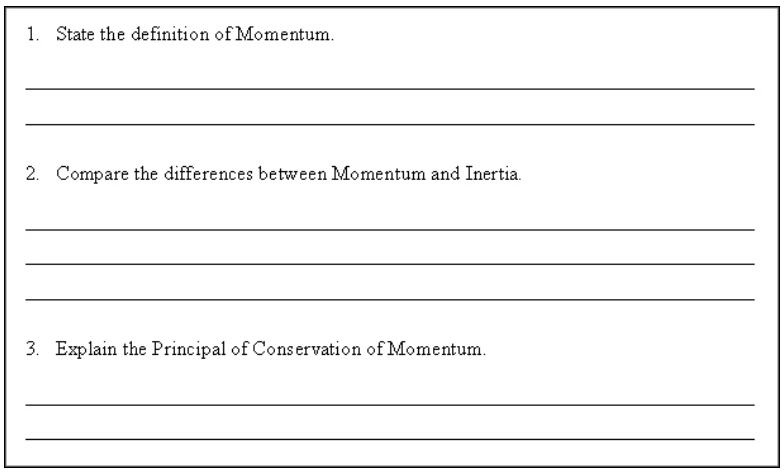

Figure 3.14: Screen shot of question

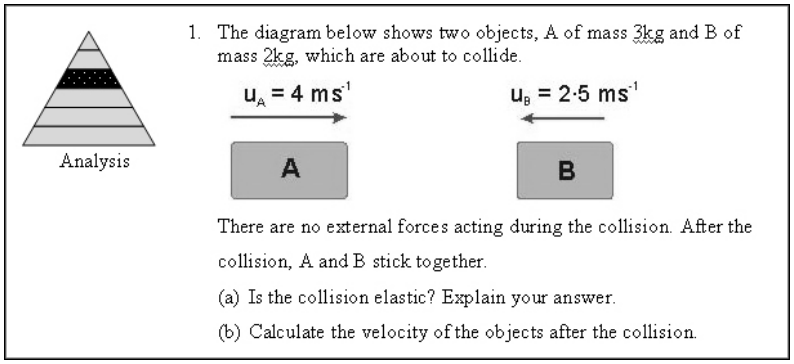

Figure 3.15: Screen shot of question

In an attempt to further participation in the *i*ELC discussion platform, students were encouraged to download the Student Instructional Activity Module from the respective topics in the Learning Forum. The uploading of these modules online was done using files and web pages resource page which provided a link to a file or a web page from one's own desktop computer (Moodle, 2003). Figure 3.16 illustrates the Resource page indicating the upload link to Momentum Exercise file.

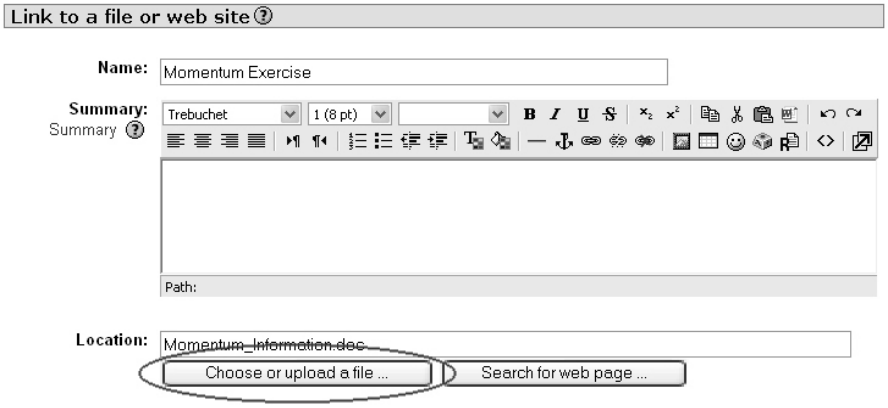

Figure 3.16: Module uploading interface

Once the necessary modules were uploaded using the resource page, it appeared as resource files. To focus on specific topics of learning, the modules were segregated to their respective topics. Figure 3.17 presents the Inertia and Momentum Exercise modules in their respective topics.

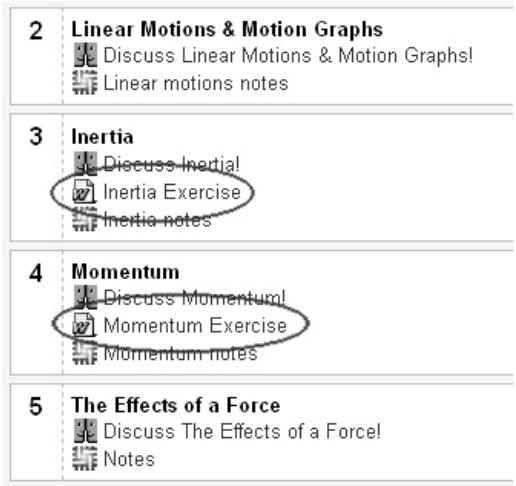

Figure 3.17: Inertia and Momentum topic modules

To download these modules, students were to click on the indicated icon for the preferred choice of topic module. Subsequently, students were presented with a pop-up window that required the user to select either the ‘Open’ or ‘Save’ button. However, students were

encouraged to click on the 'Save' button for immediate storing of the file. Figure 3.18 illustrates the module download pop-up window requesting to 'open' or 'save' the downloaded file. Figure 3.19 illustrates the pop-up window indicating the download process of the file was complete.

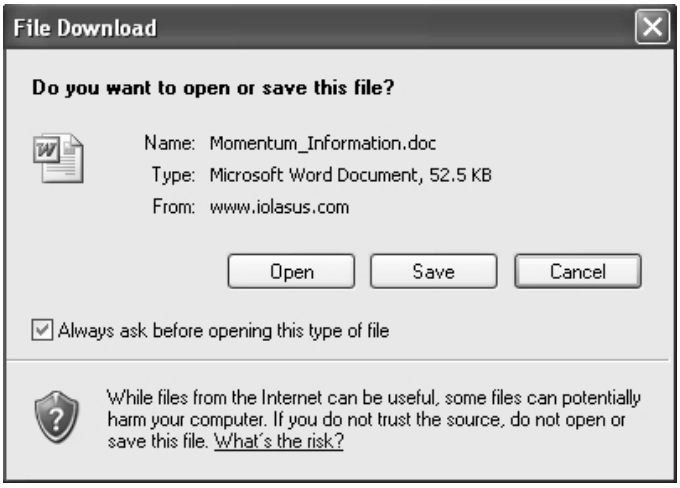

Figure 3.18: Module download pop-up window

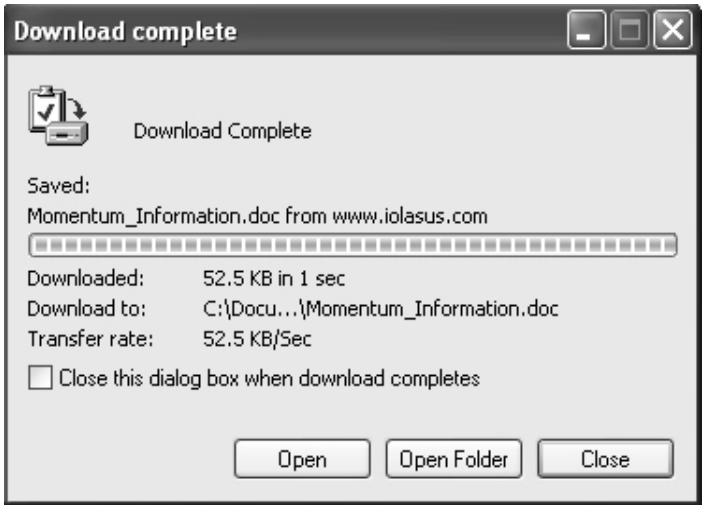

Figure 3.19: Module download complete pop-up window

3.5 Implementation Phase

In the context of the study, the Implementation phase referred to the measures taken to implement the *i*ELC discussion platform as outlined in the study (refer to Figure 3.20). The discussion of the Implementation phase was an account of the previous phases of Analysis, Design and Development. The following discussion describes how the *i*ELC discussion platform was utilized for optimal students' participation in the learning process.

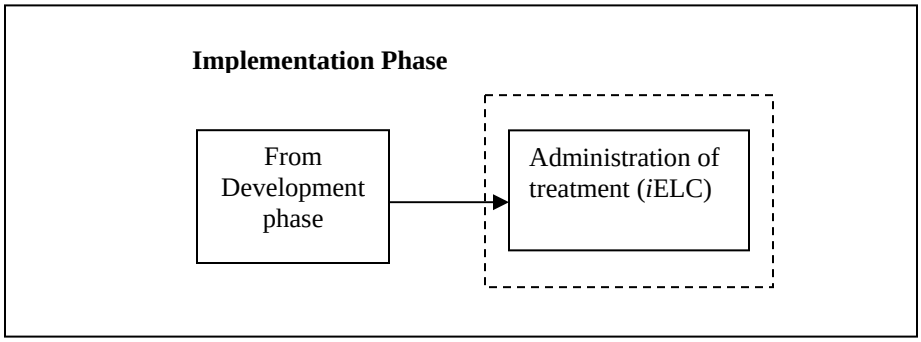

Figure 3.20: The Implementation phase operational flowchart

3.5.1 Creating a Constructivist Conducive Learning Environment

The teaching and learning process conducted in both the *i*ELC discussion platform and in classroom discussion conformed to the constructivist learning environment. This measure was necessary to ascertain optimal student-centered learning and minimal teacher-centered teaching. Santrock (2001) also emphasizes that optimal learning outcome was achieved when the student actively engage in constructing knowledge and understanding

in the learning process. Moreover, participation in a constructivist learning environment results in effective practice of self-regulated learning (Tan, 2003).

3.5.2 Engaging in Classroom Group Discussions

For the purpose of the study, the selection on the size of discussion groups was intended to deliberately instigate, sustain and develop (i) student participation in the learning process, and (ii) student-to-student interaction, which acted as the rule of thumb in tis study for participation in the *i*ELC discussion platform. The size of discussion groups was four to five students in a group, which led to an average of about six to seven discussion groups in a classroom. This measure was to provoke and sustain interaction between students during classroom discussion, which was then subtly advanced to the *i*ELC forum discussion. Richardson (2003) points out that interaction between students are able to convince students to discover and reflect on knowledge acquired during the teaching and learning process. Participation in small group discussion also allowed the teacher to better monitor a student's progress in the learning process, and his/ her participation in the *i*ELC forum discussion. Ko and Rossen (2004) supported the presence of group discussion stating that it allows the teacher an opportunity to achieve a balance between the teaching and learning process. This was again particularly imperative in the Malaysian educational context given that the teachers were required to finish the syllabus in the mentioned time period before the students were to sit for school and national examinations.

Although the classroom participation was segregated into discussion groups, the interaction of students in the *i*ELC forum discussion, however, was not segregated into groups. The reason was that this measure limited the students from actively participating in the *i*ELC discussion platform. Furthermore, chances was that only the more active students in the group maximized the use of the *i*ELC learning activity tools, which will prove to be enormously biased to the interests of the study. In addition, the Student Instructional Activity Module was used to maximize participation of the more academically challenged students into the teaching and learning process. The Student Instructional Activity Module consisted of instructional problems that subtly assess students' knowledge on the use of symbols, definition, formulas and concepts. These instructional problems were aligned on an increasing level of difficulty.

3.5.3 Engaging in the *i*ELC Discussion Platform

Grounded in an encouraging constructivist learning environment the *i*ELC discussion platform was developed to complement the traditional classroom teaching and learning approach. That is, the learning process begins in the classroom (stage 1), shifts to the *i*ELC forum for further discussion (stage 2), and concludes again through the classroom discussion (stage 3). Figure 3.21 illustrates the stages involved during participation in the *i*ELC discussion platform.

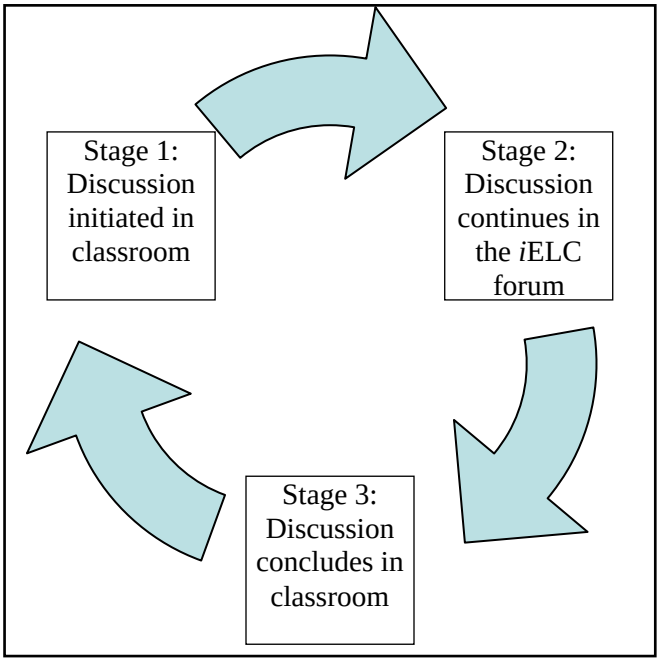

Figure 3.21: Participation in the *i*ELC discussion platform

For instance, the teacher introduced the momentum concept in classroom discussion. Then, participation in the *i*ELC forum discussion required students to further discuss the momentum concept. Examples included understanding the use of symbols (*mass*, *m* and *velocity*, *v*), the definition of momentum, the use of formula (with *momentum* being the product of *mass* and *velocity*) and solving instructional problems with regard to momentum. In this stage, the teacher imparted the fundamental use of Physics symbols, definition, formula and concepts to channel the students into the learning process. This stage also looked into the teacher being slightly dominant in the classroom than the students. The reason for this was that teacher's intervention in the learning process was necessary to ensure that syllabus was finished within the identified time frame. However, it was important to note that the teaching process conducted in the classroom focuses on students' participation in the learning process rather than absolute isolation of students' participation as was normally viewed in traditional classroom teaching.

Discussion of these aforementioned symbols, definition, formula and concept through interaction among students encouraged them to participate more effectively in the teaching and learning process. In this second stage, the students were required to play a more active role than the teachers. It was in this stage that students were encouraged to harness their practice of self-regulated learning. The aim on harnessing these strategies was to minimize rote memorization and to strengthen construction of meaningful knowledge and understanding. The teacher was also encouraged to use the Student Instructional Activity Module to positively provoke students' participation in the teaching and learning process.

After participation the *i*ELC forum discussion, classroom discussion looked into mutual role of students and teachers to conclude the students' understanding of the momentum symbols, definition, formula and concept. This learning cycle from classroom discussion to participation in the *i*ELC discussion platform and back to the classroom discussion may extend to several sessions or class periods as the teacher sees it fit. However, the advantage of participating in the *i*ELC discussion platform was that students who were not able to effectively grasp the concept of momentum for instance may seek assistance from their peers in the *i*ELC community.

3.5.4 Marking the Ground Rules

Ko and Rossen (2004) establishes that it is important to mark some ground rules to ensure smooth running of an online discussion group. In the context of this study, the

ground rules were established through discussion with experienced and inexperienced teachers and research supervisors. Suggestions and comments were also sought from students in the pilot group. These measures were taken to ensure there were no ethical conflicts between students or between students and teachers. These measures also warrant optimal students' participation in the teaching and learning process conducted in the *i*ELC discussion platform. These ground rules were explained to the students and they were handed-out a written copy of the ground rules during their first session of participating in the *i*ELC discussion platform. Teachers were also required to inform these ground rules to students prior to each sessions of participating in the *i*ELC discussion platform.

The established ground rules were as follows;

(i) Do not post inappropriate questions in the forum discussion board that may provoke anger of other students;

(ii) Do not abuse/ mock other students' answer in the forum discussion board;

(iii) Do not engage in immoral chat sessions; and

(iv) Do not engage in immoral dialogue sessions.

3.5.5 Responsibilities of Participants

In this study, only the researcher and the teachers from the experimental group were given the authority to access and direct the teaching and learning process conducted

through the *i*ELC discussion platform. The researcher shouldered the role of a webmaster, which included the following tasks;

i) To ensure the overall operation of the website;

ii) To ensure there were technical difficulties faced by the teachers and students in the process of engaging in the *i*ELC Discussion Platform;

iii) To play the secondary role of course moderator for forums. This makes certain that the researcher will have a first-hand view on the effectiveness of *i*ELC and determine ways to improve it for future use;

iv) To initiate, associate and facilitate diffusion of subject content from the *i*ELC forum discussion to classroom discussion;

v) Responsible for mediating information and discussion between one student and another;

vi) To moderate the posting and answering of topics in forums. This was to ascertain students were using the forum learning tool for the mutual interest of the *i*ELC community;

vii) To ensure students do not use the forum, chat and dialogue tool for personal matters;

viii) To regulate discussion between the *i*ELC forum discussion and classroom discussion; and

ix) To encourage optimal students' participation in the teaching and learning process in the *i*ELC discussion platform as underlined by the study.

The teachers shouldered the role of online course moderators, which included the following tasks;

i) To initiate, associate and facilitate diffusion of subject content from the *i*ELC forum discussion to classroom discussion;

ii) Responsible for mediating information and discussion between one student and another;

iii) To moderate the posting and answering of topics in forums. This was to ascertain students were using the forum learning tool for the mutual interest of the *i*ELC community;

iv) To ensure students do not use the forum, chat and dialogue tool for personal matters;

v) To regulate discussion between the *i*ELC forum discussion and classroom discussion; and

vi) To encourage optimal students' participation in the teaching and learning process in the *i*ELC discussion platform as outlined in the study.

The students played the role of primary participants of the *i*ELC discussion platform, which included the following tasks;

(i) To effectively participate in the *i*ELC discussion platform; and

(ii) To participate in regulation of discussion between the *i*ELC forum discussion and classroom discussion

3.6 Evaluation Phase

Embedded in the ADDIE instructional model, the evaluation phase is a systemic process to ascertain the quality and effectiveness of the instructional design and is divided into a formative and summative evaluation phases (Strickland, 2006). In the context of this study, the evaluation phase looked into assessing the effectiveness of the *i*ELC discussion platform before and after the *i*ELC discussion platform was tested in schools. The formative evaluation phase addressed the first objective of the study, specifically in rectifying the immediate shortcomings of the *i*ELC discussion platform. On the other hand, the summative evaluation phase addresses the second objective of the study, which was to determine the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning in the teaching and learning process.

3.6.1 Formative Evaluation

Scriven (1991) asserts that formative evaluation is aimed to improve the development of a program or a product, and can be conducted more than once. In this study, the formative evaluation process was applied interactively between the Analysis, Design and Development phases to improve the development and implementation process of the *i*ELC discussion platform (refer to Figure 3.22).

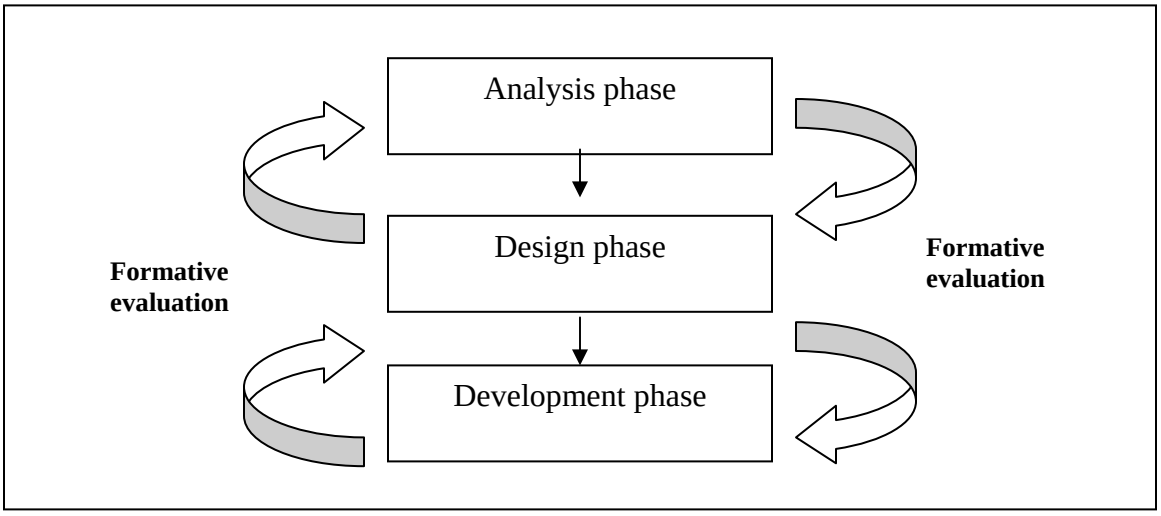

Figure 3.22: The Formative Evaluation phase operational flowchart

The Six Stages of Formative Evaluation (Strickland, 2006) was applied as a guide to conduct the formative evaluation phase. These six stages were Evaluation Goal Specification, Preparation, Data collection, Data analysis, Revision and Recycling. In the first stage of Evaluation Goal Specification, goals of the stakeholders for which the evaluation was performed were identified and specified. In the following stage of Preparation, the necessary workforce and measurements were identified and prepared. Subsequently, the Data Collection stage delineated the data collection process. The Data Analysis stage looked into assessment and tabulation of data from the previous stage. In the Revision stage, analysis of data on goals of the stakeholders directed the modification of product(s) to improve effectiveness and efficiency. Finally, the Recycling stages draws attention to the retesting of product(s) and shifts to the summative evaluation. The following discussion draws attention to the description of these six stages of formative evaluation as in the context of this study. Detailed findings of the Formative Evaluation

phase was presented in the Design, Development and Implementation phases of this chapter.

3.6.1.1 Evaluation Goal Specification

The Evaluation Goal Specification assessed goal specification prior to the actual implementation of the *i*ELC discussion platform for screen design for the *i*ELC discussion platform, target users, development of learning materials and tasks and to identify technical difficulties while accessing the *i*ELC discussion platform. These identified factors were assessed interactively between phases of developing and implementing the *i*ELC discussion platform, namely the Analysis, Design and Development phases. The purpose of the Evaluation Goal Specification stage was to ensure smooth implementation of the *i*ELC discussion platform and to advance smooth practice of self-regulated learning.

3.6.1.2 Preparation

The Preparation stage referred to the process of preparing the identified goals specified in the previous stage. This was to ensure optimal students' participation in the learning process while accessing the *i*ELC discussion platform. This stage was conducted interactively between the Analysis, Design and Development phases. These identified goals were investigated and clarified through expert review from supervisors, expert review from teachers involved in the study as well as experienced teachers in using online approach in the teaching and learning process, small group evaluation from students and pilot testing the *i*ELC discussion platform. It was also important to point out

that small group evaluation from students involved students from similar backgrounds that were not directly involved with the study. This was to avoid any possibilities on contamination of data should students from the experimental and control groups were exposed to the treatment (*i*ELC discussion platform). Finally, the *i*ELC discussion platform underwent pilot testing to mostly identify any possible pedagogical and technical difficulties while accessing the *i*ELC discussion platform. These corrections on pedagogical and technical factors were discussed in the section 4.5 “Pilot Study”.

3.6.1.3 Data Collection

The Data Collection process referred to the process of collecting data for formative evaluation and was conducted interactively between the Analysis, Design and Development phases. Hence, the data collection process was conducted through means of semi-structured interview during the developmental phases of the *i*ELC discussion platform and during the testing of the *i*ELC discussion platform prototype. The semi-structured interview method was favored because it allowed for suggestive data (Gillham, 2000). Furthermore, in specific context of this study, reviews from experts, teachers and students allowed for an insight into the accuracy and adequacy of the Form Four Physics KBSM subject content and on the diffusion of practice on self-regulated learning. In the first wave of data collection, comments and suggestions were inquired from supervisors, experienced and inexperienced teachers and students of their perception and expectations in participating in an online learning discussion. The second half of the data collection process was conducted with a finalize prototype of the *i*ELC discussion platform. The procedures involved in this point forward was mostly similar to the first half of the data

collection process, but this time the comments and suggestions received were based on the prototype of the *i*ELC discussion platform.

3.6.1.4 Data Analysis

Having established the means of collecting data, the subsequent stage of Data Analysis draw attention to the implication of data acquired in the previous stage. It must also be noted that implication of the data were brief and was only intended to assist in improving the design and development of the *i*ELC discussion platform for optimal students' participation in the teaching and learning process. Again, the Data Analysis stage was conducted interactively with the Analysis, Design and Development phases.

3.6.1.5 Revision

In the context of this study, the Revision process referred to the continual process of revising the Analysis, Design and Development phases of the *i*ELC discussion platform prior to its actual implementation in the study. The preceding four stages of formative evaluation directed any necessary improvement on the *i*ELC discussion platform. For instance, the researcher had to ensure small file size for easy downloading of the Student Instructional Activity Module and other relevant files. Where assumptions cannot be made that all internet connections were on a Broadband connection, easy downloading process imposed greatly on the feasibility of the learning task to be efficiently carried out in classrooms. Moreover, the study was conducted in regular national secondary schools with average ICT infrastructure learning environment.

3.6.1.6 Recycling

The Recycling stage referred to the process of testing the actual implementation of the *i*ELC discussion platform to achieve the identified objectives of the study. Hence, this stage of formative evaluation was not conducted because this stage coincides with the Summative Evaluation phase.

3.6.2 SUMMATIVE EVALUATION

Trochim (2006) clearly states that the summative evaluation phase differs from the formative evaluation phase. Bhola (1990) asserts that the general purpose of the summative evaluation phase was to assess the effectiveness of a program in achieving its stated objectives and outcomes. In the context of this study, the Summative Evaluation phase was conducted to investigate the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning as underlined in the second objective of the study (refer to Figure 3.23). Findings of the Summative Evaluation phase were presented in Chapters 5 and 6 of this thesis.

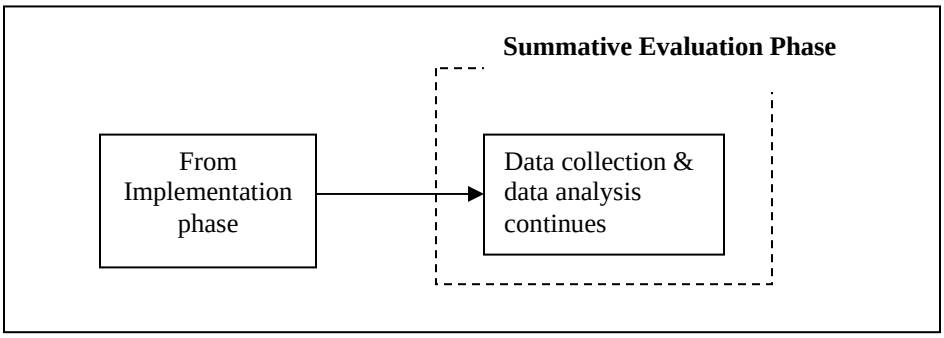

Figure 3.23: The Summative Evaluation phase operational flowchart

3.7 Chapter Conclusion

This chapter discussed the project management of the *i*ELC discussion platform. Discussion on the project management is based on the ADDIE Instructional Design model which consisted of the Analysis, Design, Development, Implementation and Evaluation phases. The Analysis phase discussed aspects fundamental to the *i*ELC discussion platform, including the objective of the *i*ELC discussion platform, its target users, scope of learning, use of instructional tool, asynchronous and synchronous participation and online course facilitators. The Design phase discussed the constructivist learning environment provided in the *i*ELC discussion platform, use of the Student Instructional Activity Module and design of self-regulated learning enablers. The Development phase discussed the development process of the Forum, Chat and Dialogue tools used in the *i*ELC discussion platform, and development of the Student Instructional Activity Module. The Implementation phase discussed setting the ground rules for participation in the *i*ELC discussion platform and the responsibilities of the participants. The Evaluation phase focused on the six stages of formative evaluation, while the summative evaluation phase was only discussed briefly. The following chapter will put forward the research methodology employed in this study.

CHAPTER 4

RESEARCH METHODOLOGY

This chapter underlines the methodology of the study. Discussion begins with description of the Pretest-Posttest and Posttest Only Nonequivalent Group Design employed to address this quasi-experimental study. Next, discussion channels into the explicating the research validity which consists of internal and external validity factors to ensure sound findings. The discussion continues with description of the self-rating instruments used to gather quantitative data from the students. This instrument was the Motivated Strategies for Learning Questionnaire (MSLQ). Attention was subsequently drawn towards the validity and reliability of the instrument, the selection of population, samples and the sampling procedures used. Tasks on the pilot study prior to the actual implementation for both the instruments used in the study and the pedagogical and technical considerations of the *i*ELC discussion platform are also described. Finally, the discussion explicates the data collection process and statistical analyses employed in the study.

4.1 Research Design

Use of sound research design will warrant the findings obtained from the research and allows the researcher to answer the research question with substantial evidence and as explicitly as possible (de Vaus, 2001). Gay and Airasian (2003) further argue that a

reliable research design will also allow the research to be replicated professionally by other fellow researchers and scholars, hence contributing to the body of knowledge. In this study, the Pretest-Posttest and Posttest Only Nonequivalent Group Design was employed to achieve the experimental objectives of the study while attempting to minimize internal and external validity factors that might doubt the findings of the study. To reiterate, the objective of the study was to investigate the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning in the learning process.

The study adopted the Pretest-Posttest and Posttest Only Nonequivalent Group Design in which the randomly identified schools were randomly assigned to the experimental and control groups. In total, the study involved participation from four schools. As underlined by the Pretest-Posttest and Posttest Only Nonequivalent Group Design, one school was subjected to both a pretest and posttest while the other school was subjected to only a posttest. This applied for both the experimental and control groups. This research design was favored because it minimized possibilities on contamination of data due to pre-testing procedures and reactive effects of testing, in addition to other forms of internal and external validity threats. Figure 4.1 is a graphical representation of the Pretest-Posttest and Posttest Only Nonequivalent Group Design. The experimental group was exposed to the *i*ELC discussion platform and was assessed quantitatively on how the self-regulated learning was practiced in the *i*ELC discussion platform. On the other hand, the control group was exposed to traditional face-to-face approach but again assessed

quantitatively on how the self-regulated learning was practiced in traditional learning environment.

(E) School Group 1:	O_1	X	O_2
(C) School Group 2:	O_3		O_4
(E) School Group 3:		X	O_5
(C) School Group 4:			O_6

Symbols

X	:	Treatment
$O_{1, 3}$	:	Pretest
$O_{2, 4, 5,6}$	:	Posttest
E	:	Experimental
C	:	Control

Figure 4.1: Pretest-Posttest and Posttest Only Nonequivalent Group Design

The pretest was administered to determine the samples' initial practice of self-regulated learning prior to the experimental groups' exposure to the treatment. Subsequent to the treatment all the experimental and control groups were subjected to the posttest. The posttest was administered to determine the students' practice of self-regulated learning in the samples' respective learning process. Comparison of mean scores between posttests of the experimental and control groups established the point of significance on the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning. The posttest utilized identical instruments and measurements that were used during the pretest.

4.2 Research Validity

Tuckman (1999) argues that success in a social science research was subject to the influences of the human factor. The reason for this was that it was not easy to control or eliminate extraneous variables and manipulate the relevant variables in a social science research. The ability to control or eliminate extraneous variables and manipulate the relevant variables was referred to as the validity of a research design (Gay & Airasian, 2003; Tuckman, 1999). Validity of a research design address the capacity of the research design to deliver the conclusions that the researcher claims it delivers (de Vaus, 2001). The two fundamental concepts of validity are internal validity and external validity, and are of pivotal importance in any sound research design (Gay & Airasian, 2003; de Vaus, 2001; Tuckman, 1999).

4.2.1 Internal Validity

Internal validity refers to the degree to which the design of the research authorizes the researcher to derive unambiguous conclusions from the findings of the research (de Vaus, 2001). Internal validity establishes the certainty for the findings of the research; any difference that occurs between the pretests and posttests interval was the result of the treatment administered instead of influences from other extraneous variables (Gay & Airasian, 2003; de Vaus, 2001; Tuckman, 1999). In the context of this study, control of internal validity threats determined the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning in the learning process.

According to Campbell and Stanley (1963), following are the list of internal validity threats: History, maturation process, pretesting procedures, measuring instruments, statistical regression, experimental mortality, differential selection of subjects and selection-maturation interaction.

4.2.1.1 History

The history factor refers to an event(s) other than the treatment that may have occurred between the pretest and posttest interval (Tuckman, 1999). The reason being that event(s) that might have occurred during the pretest-posttest interval would have influenced the administration of the treatment or affected the subjects to have more keen interest, or less, hence contaminating the findings of the research. However, Campbell and Stanley (1963) argue that a historical event or a combination of historical events, which might have produced extraneous variables during the pretest-posttest interval in the experimental group, is most likely to produce similar differences in the control group. In other words, extraneous variables produced by a historical event(s) during the pretest-posttest interval in the control group balances out extraneous variables produced by a historical event(s) in the experimental group (Campbell & Stanley, 1963). Also, the researcher undertakes justified assumption that the history factor in context of this study did not inhibit the findings but in fact contributes to the strength of the finding. Reason being that it was customary for students engaged in online learning to be subjected to various teaching and learning situations. In the context of this study, participation in the *i*ELC discussion platform was implemented in different schools under various history factors. Yet, a significant finding will only establish the effectiveness of the *i*ELC discussion platform in

advancing practice of self-regulated learning in the learning process, and its feasibility to be used in regular national secondary schools. Thus, the history factor did not pose a threat to the internal validity of the design.

4.2.1.2 Maturation Process

Campbell and Stanley (1963) points out that in a lengthy research, the subjects may go through some biological or psychological process. In view of the fact that the duration of this research was only eight weeks and that, the subjects were already of above puberty age, it was very unlikely for the subjects to go through any biological changes. However, the researcher does not deny the fact that the subjects might experience emotional changes of some extent, particularly academic stress, due to the increasing number of assignments or peer pressure. But again due to the presence of the control group an assumption can be established on grounds that the emotional change that the subjects in the experimental group may experience is similar to the emotional changes that the subjects in the control group may experience, thus balancing out each other (Campbell & Stanley, 1963). However, the researcher does expect to see some positive changes in the subjects' regulation of motivation and learning strategies through participation in the *i*ELC discussion platform. Thus, academic and emotional maturation of the subjects in the domains of self-regulated learning was an anticipated outcome and hence will not be viewed as an internal validity threat.

4.2.1.3 Pretesting Procedures

According to Campbell and Stanley (1963), answering the pretest prior to the commencement of the treatment might interfere with the subjects' performance in the posttest. That is, the subjects' awareness of the pretest that has caused them to work harder for the treatment and eventually the posttest.

Also, the self-rating instruments used to measure the practice of self-regulated learning did not pose an internal validity threat based on several grounds. First, the MSLQ instrument was not utilized to measure factual information. This was because the pretesting procedure was more likely to pose a threat in studies that assess factual information, for instance, mathematical equations, rather than non-factual information (Gay & Airasian, 2003). Second, pretesting procedures did not affect the subject's participation in the research or, his or her perception of the treatment because students were accustomed to testing (Ary, Jacobs & Razavieh, 2005). Thirdly, as an extension of the second point mentioned above, the subjects will not vividly remember the items posed in the pretest given the fact that the interval between the pretest and posttest was eight weeks, which has been deemed sufficient by the researcher and the supervisors of this study. Finally, the rigorous approach of the Pretest-Posttest and Posttest Only Nonequivalent Group Design eliminates any possibilities of pretesting threats. Comparison of two-way between subjects analysis of variance between pretested and non-pretested groups will rule out pretesting threats.

4.2.1.4 Measuring Instruments

According to Campbell and Stanley (1963), instruments that are not reliable or autonomous changes in the measuring instrument might account for the difference in the pretest-posttest results. Gay and Airasian (2003) further added that instruments with different level of difficulty, or lack of consistency, may also contribute to misleading findings of the research. With respect to the abovementioned arguments, the researcher was certain that the measuring instrument factor was not a threat to internal validity in this study.

First, the Motivated Strategies for Learning Questionnaire (MSLQ) that was utilized in this research was indeed highly valid and reliable (Pintrich et al., 1991). The validity and reliability of the MSLQ instrument was checked by a panel of experts in their respective field and in a pilot study. The pilot study results indicated that the scales utilized in this research were valid and reliable as reported in 4.5 on “Pilot Study”. Secondly, the same instrument will be used for the pretest and the posttest. This ensures that there were no difference in the level of difficulty in the instruments that were administered to the subjects in the pretest and the posttest.

4.2.1.5 Statistical Regression

According to Campbell and Stanley (1963), statistical regression continues, even without the presence of the treatment, when subjects with extreme scores in the pretest regress towards the mean of the posttest. That is, subjects with extreme high scores on average tend to decline towards the mean while subjects with extreme low scores on average tend

to improve towards the mean (Ng, 2005). However, Gay and Airasian (2003) assert that statistical regression was more likely to occur when subjects with extreme scores were deliberately selected into the experimental and control groups. Given the fact that the subjects with extreme scores in this research were not purposively assigned to the experimental and control groups, statistical regression did not pose a threat to the internal validity of the research.

4.2.1.6 Experimental Mortality

According to Tuckman (1999), it is essential that posttest data must be obtained from all subjects included in the research. Gay and Airasian (2003) pointed out that experimental mortality may pose as a threat to the internal validity of the research if the subjects fail to remain as subjects in the research during the designated duration of treatment. Campbell and Stanley (1963) pointed out that differential loss of subjects from the experimental and control group is likely to produce sample bias. However, the experimental mortality factor did not pose a threat to the internal validity of this research due to several grounds. First, Form Four Physics subject was a compulsory subject for all science stream students. Moreover, the treatment was only implemented several weeks after the school has started for the year, thus, any shifting streams would have been taken care of. Second, the frequency of absenteeism was usually minimal and unintentional. However, this frequency of absenteeism was present in both the experimental and control group. Since both the subjects in the experimental and control group were not aware of the treatment, or that they were involved in a research, hence, this factor on experimental mortality balances out one another.

4.2.1.7 Differential Selection of Subjects

Differential selection of subjects refers to the bias that occurs when the treatment group includes subjects that are more competent, more receptive, or older in comparison to the control group (Tuckman, 1999). That is, important differences had already existed between the experimental and control group even before the administration of the treatment. The differential selection of subjects' factor may cause the findings on the experimental group to be a cut above from the findings of the control group, not because of the treatment itself, but because the experimental group differs from the control group in one way or another (Tuckman, 1999). However, the differential selection of subjects' factor did not pose a threat to the internal validity of this study based on several grounds. In the context of this study, groups of schools, not subjects, that were randomly assigned to the experimental and control groups. All the same, this will minimize the threat of the differential selection of subjects because every group of school, and thus the students in it, will possess equal probability to be selected into the experimental and control group. Second, there were a large number of samples participating for the study implying that any unanticipated bias that might occur in the experimental group due to the competency of the subjects was minimal.

4.2.1.8 Selection-Maturation Interaction

Selection-maturation interaction factor refers to the initial advantage of one group over the other due to the maturation process of the subjects (Gay & Airasian, 2003). The selection-maturation interaction factor poses a threat mostly in a quasi-experimental research when intact groups are used for the experimental and control groups (Gay &

Airasian, 2003). However, the presence of the control group balances any possibility of the selection-maturation interaction factor in the experimental group. Moreover, the random assignment of schools into randomly selected experimental and control groups will rule out the selection-maturation interaction internal validity threat. In addition, the subjects were of the same age group since they were in Form Four. Thus, any unanticipated bias in the level of maturation that might occur in favor of any of the groups was minimized.

4.2.2 External Validity

According to Campbell and Stanley (1963), external validity refers to the extent to which a research can be generalized to a larger population of similar characteristics, the treatment and the measured variables. Tuckman (1999) points out that it is the intention of any researcher to have his or her research be generalized and replicated to other subjects in similar settings. Tuckman (1999) further pointed out that there are four factors that pose as a threat to the external validity of a research, which are reactive effects of testing, interaction effects of selection bias, reactive effects of experimental arrangements and multiple treatment interference.

The findings of this research, though not generalizable to the entire population of regular national secondary schools in Kuala Lumpur, it was, nevertheless, still generalizable to regular national secondary schools of similar characteristics. This was because the appropriate measures for external validity threats have been weighed in great detail. The

following discussion puts forward external validity threats that have been taken into consideration in the process of designing and implementing this research.

4.2.2.1 Reactive Effects of Testing

According to Tuckman (1999), the reactive effects of testing factor occurs when the subjects become alert that they are involved in a research or exposed to a treatment. The reactive effects of testing also occur when subjects are alert of being exposed to pretest activities (Tuckman, 1999). The reactive effects of testing factor will not be a threat to this study based on several grounds. First, the rigorous approach of the Pretest-Posttest and Posttest Only Nonequivalent Group Design implemented in this study requires randomly identified schools to be randomly assigned to the experimental and control groups, allowing no chances of the experimental group to be aware of the control group. Moreover, Ary et al. (2005) justifies that because the subjects are accustomed to testing during their education years the reactive effects of testing factor will not pose an external validity threat to the study. Even in the Malaysian context, the students have experienced testing in terms of monthly, mid-term and final-tem examinations.

4.2.2.2 Interaction Effects of Selection Bias

According to Tuckman (1999), the interaction effects of selection bias factor occurs when the samples that are selected for the research do not entirely represent the population. In the context of this study, the four schools were randomly selected from the number of schools in Kuala Lumpur, thus representing the population. The schools were then

randomly assigned to the experimental and control groups. If a school had more than one Physics class, then only one class was randomly assigned.

4.2.2.3 Reactive Effects of Experimental Arrangements

According to Tuckman (1999), the reactive effects of experimental arrangements factor occurs when the arrangement of the experiment, or the experience of participating in it, creates a simulated situation, which "limits the generalizability of the results to a non-experimental test of the treatment" (p. 140). This is also referred to as the Hawthorne Effect (Tuckman, 1999). In other words, the Hawthorne Effect refers to the increase in performance driven by the "inclusion in an experiment" (Tuckman, 1999, p. 140). That is, the subjects of the experimental group realizing that they are being experimented on or pleased to be singled out to participate in an experimental group exerts extra effort and thus performs above expected average. However, the Hawthorne Effect will not be a threat to the external validity of the research due to several grounds. This was owing to the fact that the subjects in both the experimental and control groups were not aware of the fact that they were involved in a research.

Moreover, the teachers from the experimental and control groups were made aware of their respective roles as reported in section 3.5.4 on "Marking the Ground Rules". This step was taken to reduce unintentional bias caused by these teachers in favor of their group. Even so, the teachers were cautioned by the researcher from time to time as not to be directly involved in the participation in the *i*ELC Discussion Platform but to adhere to

the guidelines as specified by the researcher. This was to ensure that the teachers did not unintentionally contaminate the findings of the study.

4.2.2.4 Multiple-Treatment Interference

Multiple-treatment interference occurs when the subjects are subjected to a number of other treatments in addition to the research treatment which may affect their performance that was intended for the actual research treatment (Tuckman, 1999). In the context of this research, the multiple-treatment interference factor might pose a threat to the external validity. In the current study, the threat of multiple interference was not significant. This was largely because the treatment was administered in adjunct to other classroom activities and group work from other subjects such as Chemistry, Biology, History and the English Language.

This interference of other instructional activities might have some influence on the subjects' appreciation and practice of self-regulated learning in the learning process. However, subjects from both the experimental and control group were exposed to similar instructional activities and assignments. In other words, extraneous variables, if any, produced in the experimental group were most likely to produce similar differences in the control group, hence balancing each other.

4.3 Instrumentation

A set of questionnaire was used to acquire the necessary data for the study (refer to Appendix C). The questionnaire (refer to Appendix C) was divided into two parts. Part A measured the students' demographic variables. Part B uses the Motivated Strategies for Learning Questionnaire (MSLQ) to achieve the second objective of this study. The second objective of this study was to investigate the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning strategies in the learning process. The MSLQ consists of the Motivation Scale and the Learning Strategies Scale. The researcher had obtained permission to use the MSLQ instrument (refer to Appendix A2).

The entire set of this questionnaire was developed in the English language. To accommodate the national Malay language used in Malaysian schools, the questionnaire was subjected to back-to-back translation by experts in the English language and the Malay language. That is, the questionnaire which was initially developed in the English language was translated into the Malay language by the researcher. The Malay version of the questionnaire is then translated back to the English language to double-check for accuracy in terms and sentences. This back-to-back translation is checked by experts with expertise in both the English and the Malay language.

In addition, experts in practices of self-regulated learning were also referred to ensure the validity of the instrument. As de Vaus (2001) points out, validity refers to the indicator of

an instrument to measure the concept it claims. It is important to determine the validity of a research instrument to caution internal validity threats and to ascertain strong findings (de Vaus, 2001; Ebel & Frisbie, 1991). Instruments that are reliable are also reproducible and generalizable to other similar testing occasions (Ebel & Frisbie, 1991). Five experts were used to check on the content validity and two experts were used to check on the back-to-back translation. Refer to Appendix B1 for the experts identified.

4.3.1 Part A: Demographic Scale

The Demographic Scale consisted of six items measuring students' gender and their use of computers and the Internet for instructional purposes in the Physics learning process. Item 1 was a yes/ no dichotomous item requiring students to state whether they own a computer at home. Item 2 was an open ended question requiring students to state the number of years they have been using the computer. Item 3 was also a yes/ no dichotomous item requiring students to state whether they have Internet access at home. Items 4 to 6 were measured on an ascending 5 point Likert scale ranging from 'Never' to 'Always'. Item 4 measured the average frequency of students' access to the Internet in a day. Item 5 measured the average frequency of students revising the Form Four Physics KBSM subject on the whole. Item 6 measured the average frequency of students' accessing the Internet for Physics instructional purposes.

4.3.2 Part B: Motivated Strategies for Learning Questionnaire (MSLQ)

The Motivated Strategies for Learning Questionnaire (MSLQ) is a self-report instrument designed to measure motivational orientations and their use of different and various learning strategies (Pintrich et al., 1991). The MSLQ instrument comprised of two scales, the Motivation Scale and the Learning Strategies Scale. The pre-MSLQ instrument varied in length from 50-140 items during the period of 1982 to 1986 (Garcia & McKeachie, 2005). The 1991 final version of the MSLQ instrument consists of 81 items (Pintrich et al., 1991). The items were scored on a 7-point Likert-type scale, ranging from 1 (not at all true of me) to 7 (very true of me). There were a total of 15 scales and can be used together or singly. The scores on the identified items of a subscale were summed and computed on an average value. This average value indicated the mean for that particular subscale. With the items lined on a 7-point Likert scale, the minimum possible score was 1 while the maximum possible score was 7 (Ng, 2005). For example, the Rehearsal subscale was made up of 4 items; thus, the minimum possible score was 4 while the maximum possible score was 28. Table 4.1 indicated the list of items for the Motivation and Learning Strategies Scales. All the items were positively worded. Standard deviation was used as the index of variability since self-regulated learning scores were computed on an interval scale (Ng, 2005; Pallant, 2001).

Table 4.1: List of items for Motivation and Learning Strategies Scales

Motivation Scale	
Intrinsic Goal Orientation	9, 13, 14
Extrinsic Goal Orientation	4, 6, 8, 16
Control of Learning Beliefs	1, 5, 10, 15
Self-Efficacy for Learning & Performance	2, 3, 7, 11, 12
Learning Strategies Scale	
Rehearsal	26, 36, 45, 46
Elaboration	31, 32, 39, 40, 42, 53
Organization	17, 23, 28, 38
Critical Thinking	21, 30, 44
Metacognitive Self-Regulation	19, 33, 34, 52
Time & Study Environment	24, 29, 43, 47, 51
Effort Regulation	20, 27, 37, 48
Peer Learning	18, 25, 50
Help Seeking	22, 41, 49

4.3.2.1 Modified MSLQ Instrument for the Study

Although the instruments had already been tested for its reliability by its authors (Pintrich et al., 1991), the instrument had been modified for the purpose of this research. Thus, there was a need to double check on the validity and reliability of the instrument. Besides, the instrument was previously used in a different setting (Ebel & Frisbie, 1991).

Hence, the reliability of the instrument was determined during a pilot study in another school using the Cronbach alpha value. The Cronbach alpha value was used to establish the internal consistency reliability of the research instruments (Ebel & Frisbie, 1991). The initial Motivation Scale of the MSLQ instrument consisted of 6 subscales, which were intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance and test anxiety. The task value and test anxiety subscales were omitted from the instrument after modification. The MSLQ instrument was still valid even without the task value and test anxiety subscales. Appendix E2 forwards and email correspondence between the researcher and the author of the MSLQ instrument, Bill McKeachie, on the enquiry of omitting the task value and test anxiety subscales.

The task value subscale measured the students' evaluation of how they perceive the tasks to be interesting, important and useful to them (Pintrich et al., 1991). In the context of this study, the task value subscale would have measured students' evaluation of how they perceive the Form Four Physics KBSM subject related tasks assigned to them through participation in the *i*ELC discussion platform to be interesting, important and useful to them. However, this task value subscale was omitted because it was not appropriate to the needs of the study (Kamariah Abu Bakar, personal communication, January 11, 2007). That is, the Physics KBSM subject was compulsory to be taken by all students enrolled in the science streams. Hence, all students in the science stream would have to sit for the Physics KBSM subject even though they would have not perceived the subject to be interesting, important or useful to them.

The test anxiety subscale measured students' negative concerns and preoccupations on the difficulty of the subject that would result in poor performance of the subject. In the context of this study, the test anxiety subscale would have measured the students' negative concerns and preoccupations on the obligatory need to sit for the subject and to eventually obtain a good grade. This test anxiety subscale was omitted because it was also not appropriate to the needs of the study (Kamariah Abu Bakar, personal communication, January 11, 2007). First, the samples of the study were Form Four Physics students who were only newly exposed to the Physics subject. Reason was that the Physics subject was only offered in higher secondary for Form Four and Form Five students. The general science subject that these students sat for in Form Three was definitely not as demanding as the Physics KBSM subject. Form Five Physics students were not selected for the study because it was not allowed by the Ministry of Education and the school authorities on grounds that they are busy preparing for the major national examinations.

Hence, the modified Motivation Scale consists of 4 subscales, which were intrinsic goal orientation, extrinsic goal orientation, control of learning beliefs and self-efficacy for learning and performance.

The initial Learning Strategies Scale consists of 9 subscales, which were rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning and help seeking. All nine subscales were included in the modified Learning Strategies Scale. Modification on this scale referred to

the rewording of items and development of new items to accommodate the needs of the study.

4.3.2.2 Modification of MSLQ Items

The MSLQ instrument was carefully modified to cater for specific need of the study. The modifications made were as follows:

1. The term '*subjek Fizik*' [Physics subject] was included in the necessary items to channel students to answer the questionnaire as reflected by their participation in the learning the Physics subject.

2. Item 3 was reworded to include in the terms '*perbincangan kelas dan perbincangan forum*' [classroom discussion and forum discussion].

   'I'm certain I can understand the most difficult material presented in the readings for this course'… was changed to… '*Saya yakin bahawa saya dapat memahami bahan yang paling sukar dalam subjek Fizik dengan bantuan perbincangan kelas dan perbincangan forum*' [I am certain I can understand the most difficult materials presented in the Physics subject with help from classroom discussion and forum discussion].

3. Item 6 was reworded to replace the words 'overall grade point average' with '*pencapaian keseluruhan*' [overall performance].

‘The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade’… was changed to… ‘*Perkara yang paling penting bagi saya ketika ini adalah membaiki pencapaian keseluruhan saya. Oleh it, tumpuan utama saya ialah memperoleh gred yang baik dalam subjek Fizik*’ [The most important thing for me right now is improving my overall performance. So, my main concern is getting a good grade for the Physics subject].

4. Item 16 was reworded to replace the words ‘family, friends, employer, or other’ with ‘*orang lain*’ [others].

   ‘I want to do well in this class because it is important to show my ability to my family, friends, employer, or others’… was changed to… ‘*Saya ingin mendapat kejayaan dalam subjek Fizik kerana kejayaan itu penting untuk menunjukkan kemampuan saya kepada orang lain*’ [I want to do well in this class because it is important to show my ability to other].

5. Initial negatively worded items were positively reworded. The results reported in Chapter 5 represent the positively worded statistics. These negatively worded items were items 20 and 37.

   Item 20: **(Negatively worded)**

   Saya berasa sungguh malas atau bosan untuk belajar subjek Fizik sehingga saya biasanya berhenti sebelum menyelesaikan apa-apa yang telah saya rancangkan.

   [I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do].

(Positively reworded)

*Saya **tidak** berasa sungguh malas atau bosan untuk belajar subjek Fizik sehingga saya biasanya berhenti sebelum menyelesaikan apa-apa yang telah saya rancangkan.*

[I **do not** often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do].

Item 37: **(Negatively worded)**

Apabila mendapati subjek Fizik itu sukar, saya akan berputus asa atau menelaah bahagian yang mudah sahaja.

[When course work is difficult, I either give up or only study the easy parts].

(Positively reworded)

*Apabila mendapati subjek Fizik itu sukar, saya **tidak** akan berputus asa atau menelaah bahagian yang mudah sahaja.*

[When course work is difficult, I **do not** give up or only study the easy parts].

6. The terms 'Lecture' and 'Instructor' were replaced with *Kelas* [Class] and *Guru* [Teacher] in the necessary items.

7. Item 22 was reworded to include in the term *'bantuan rakan atau guru'* [Assistance from friends/ classmates or teacher] and *'perbincangan kelas atau perbincangan forum'* [Classroom discussion or forum discussion].

'When I become confused about something I'm reading for this class, I go back and try to figure it out'… was changed to… *'Saya akan merujuk bantuan rakan atau guru melalui perbincangan kelas atau perbincangan*

forum apabila saya menghadapi masalah mempelajari subjek Fizik' [I will look out for assistance from friends/ classmates or teachers through means of classroom discussion or forum discussion when I am faced with difficulties in learning the Physics subject.

8. Item 28 was reworded to exclude the words 'simple charts, diagrams, or table and was replaced with *'nota sendiri'*. This was to simplify the students' understanding of this item.

   'I make simple charts, diagrams, or tables to help me organize course material'… was changed to… '*Saya akan membuat nota sendiri bagi subjek Fizik untuk membantu saya menyusun atur bahan pelajaran*' [I will construct own notes for the Physics subject to organize the learning materials].

9. Item 31 and 32 of the modified Learning Strategies Scale was reworded because it was a double-barrel item (Wong Su Luan, personal communication, January 8, 2007).

   'When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions'… was changed to… '*Saya akan mengaitkan maklumat daripada pelbagai sumber bercetak (seperti nota kelas, bahan bacaan tambahan) untuk mengukuhkan pemahaman saya tentang subjek Fizik'* [I will relate information from printed materials (such as class notes and additional readings) to strengthen my understanding of the Physics subject, Item 31] and '*Saya akan mengaitkan maklumat daripada perbincangan kelas dan perbincangan forum untuk mengukuhkan pemahaman saya tentang subjek Fizik*' [I will relate information from classroom discussion and forum discussion to strengthen my understanding of the Physics subject, Item 32].

10. Item 41 was reworded to include in term '*perbincangan forum*' [forum discussion].

> 'When I can't understand the material in this course, I ask another student in this class for help'… was changed to… '*Jika saya tidak memahami subjek Fizik, saya akan mendapatkan bantuan pelajar lain melalui perbincangan kelas atau perbincangan forum*' [If I cannot understand the Physics subject, I will seek help from another student in this class or through the forum discussion].

11. Item 45 and 46 of the modified Learning Strategies Scale was reworded because it was a double-barrel item (Wong Su Luan, personal communication, January 8, 2007).

> 'I make lists of important items for this course and memorize the lists'… was changed to… '*Saya membuat senarai isi penting bagi subjek Fizik'* [I make lists of important items for the Physics subject, Item 45] and '*Saya menghafal senarai isi-isi penting yang telah saya buat untuk subjek Fizik*' [I memorize the important lists that I make for the Physics subject, item 46].

12. Item 51 was reworded to include in term '*perbincangan forum*' [forum discussion].

> 'I often find that I don't spend very much time on this course because of other activities'… was changed to… '*Saya selalu mendapati saya tidak meluangkan masa yang mencukupi untuk perbincangan forum Fizik disebabkan aktiviti-aktiviti lain*' [I often find that I don't spend very much time in the Physics forum discussion because of other activities].

13. Item 53 was reworded to include in term '*perbincangan forum*' [forum discussion].

> 'I try to apply ideas from course readings in other class activities such as lecture and discussion'… was changed to… '*Saya cuba mengaplikasikan*

idea-idea daripada bahan pelajaran dalam aktiviti-aktiviti yang lain seperti perbincangan kelas dan perbincangan forum' [I try to apply ideas from learning materials in other activities such as classroom discussion and forum discussion].

4.4 Population and Sampling

Population refers to a large heterogeneous group with similar characteristics in which a research is conducted upon (Grimm & Wozniak, 1990). In the context of the study, the identified population was Form Four Physics KBSM students from regular national secondary schools in the state of Kuala Lumpur. Grimm and Wozniak (1990) stressed that the purpose for any social science research is to infer to a larger population, although it is usually not feasible to do so.

Thus is the reason as to why a sample that represents the population is necessary. In the context of this study, the identified samples of the study were the Form Physics KBSM students from four randomly selected regular national secondary schools from the zones of Pudu and Bangsar in the state of Kuala Lumpur. Out of the four randomly identified schools the two schools randomly assigned to the experimental group were SMK. Miharja and SMK. Aminuddin Baki, while the remaining two schools randomly assigned to the control group were SMK. Vivekananda and SMK. Bukit Bandaraya. Table 4.2 presents the random assignment of schools into the experimental and control groups.

Table 4.2: Random assignment of schools into the experimental and control groups

Random assignment of schools	Grouping	School
Experimental	E1	SMK. Miharja
	E2	SMK. Aminuddin Baki
Control	C1	SMK. Vivekananda
	C2	SMK. Bukit Bandaraya

Sample is a relative fraction of the population that is actually selected to undergo the research (Grimm & Wozniak, 1990). Roscoe (1975) asserts that in most experimental research, samples of a minimum of 30 subjects were reasonable. On the contrary, Chassan (1979) points out that a range of 20 to 25 subjects for each independent variable group were sufficient to address the minimum probability to detect a difference in the treatment administered.

However, Gay and Diehl (1992) state that the number of subjects in a sample depends necessarily on the type of research the researcher is advocating. Thus, Gay and Airasian (2003) establish that 15 subjects per experimental and control group was deemed as the minimum in context of a quasi-experimental research. On these grounds, the samples for the study were deemed sufficient.

The schools were selected in a two-stage cluster sampling technique. In the first stage, two zones in Kuala Lumpur were randomly selected to represent the selection of the experimental and control group. The reason for selecting two different zones was to

ascertain that the experimental groups were not in contact with the control group to prevent major contamination of data. In the second stage, two schools were randomly selected in each of these zones and randomly assigned to the respective experimental and control groups. In a case where a school had two and more Form Four Physics classes, then only one out of these classes would randomly assigned to the experimental or control group. Also, it was necessary for both experimental schools to be in the same zone for the *i*ELC discussion platform to be able to function from the same Internet server. This measure was to avoid differences in the implementation of the study and in the results that may cause technical difficulties such as downloading of learning materials, delay in receiving forum posts and completion of online learning tasks.

Further confirmation on the selection of schools was based on the adequacy of ICT infrastructure and facilities. It was to ensure that both the experimental and control schools had similar ICT infrastructures; that were, at least a 2:1 student computer ratio and access to Internet facilities. This was to ensure that lack of ICT infrastructure and facilities would not be an inhibiting factor to the study. It was also interesting to note that although the students managed to grasp the concept of online community discussion, most of them were not able to discriminate between online learning and the general use of computers in the teaching and learning process, which may include the use of PowerPoint presentations, word processors, and instructional courseware. This established the need to brief students about the *i*ELC discussion platform prior to participation in the study.

4.5 Pilot Study

The following discussion describes the implementation of the pilot study which was carried out in two phases. The pilot study was conducted only in one school which was the Sekolah Menengah Kebangsaan (SMK.) Datok Lokman. The first phase focused on the self-rating instruments used and was tested for its validity and reliability. The second phase of the pilot study focused on the assessment of the *i*ELC discussion platform for technical and pedagogical aspects. The main purpose of the pilot test was only to detect and identify any possible flaws in the study and was not intended to investigate the identified objectives of the study (Ng, 2005). The entire process of the pilot study was conducted in duration of six weeks, with the testing of the instruments consuming two weeks and testing of the *i*ELC discussion platform consuming the remaining four weeks. Table 4.3 presents the duration and tasks of the pilot tests.

Table 4.3: Duration and tasks of the pilot tests

Task Phase	Duration	Tasks
Pilot study for instruments	1st Feb 2007 – 5th Feb 2007	Testing of research instruments in school
	6th Feb 2007 – 12th Feb 2007	Correction of research instruments
Pilot study for the *i*ELC discussion	13th Feb 2007 – 16th Feb 2007	Testing of the *i*ELC discussion platform for pedagogical factors
	17th Feb 2007 – 25th Feb 2007	Correction for pedagogical

platform		factors (on how participation in the *i*ELC discussion platform can be optimized)
	26th Feb 2007 – 2nd March 2007	Testing of the *i*ELC discussion platform for technical factors
	3rd March 2007 – 9th March 2007	Correction for technical factors (downloading and uploading of materials)

The pilot study for the testing of the self-rating instruments was conducted from the 1st Feb 2007 till the 5th Feb 2007. The samples involved were Form Four Physics KBSM students (n = 37) of which were 25 females and 12 males. There were no doubts raised by students during the pilot testing of the instruments. Hence, there were no corrections necessary for the items in the instruments. This indicated that the items were clear, comprehensible by students and for administration for the actual study. However, the instrument was subjected to minor improvement on face validity (to synchronize font size) in the following week. As for the reliability analysis, the modified MSLQ instrument obtained a Cronbach alpha value of 0.93.

The pilot study for the testing of the *i*ELC discussion platform was conducted in SMK. Datok Lokman from the 13th Feb 2007 till the 9th March 2007. The *i*ELC discussion platform was tested from the 13th Feb 2007 till the 16th Feb 2007 for pedagogical factors. This included: (i) how students perceived participating in the *i*ELC discussion platform;

(ii) how students perceived participating in the forum discussion; (iii) how students perceived using the dialogue tool; and (iv) how students perceived using the chat tool. During the pilot test, doubts were raised by both students and teachers, which were: (i) the students' role during participation in the *i*ELC discussion platform; (ii) the teachers' role during participation in the *i*ELC discussion platform; and (iii) the researcher's role during participation in the *i*ELC discussion platform. These doubts on the roles of the students, teachers and the researcher were answered and were then documented in section 3.5.5 "Responsibilities of Participants in Chapter 3". Subsequent to these doubts, discussions on marking the ground rules during participation in the *i*ELC discussion platform was included in section 3.5.4 "Marking the Ground Rules" in Chapter 3 of this thesis.

The *i*ELC discussion platform was then tested from the 26th Feb 2007 till the 2nd March 2007 for technical factors such as posting of forum discussion threads and uploading to and downloading of files from the *i*ELC discussion platform. There were no doubts raised by students and the teacher. This was due to the fact that navigation in the *i*ELC discussion platform was fairly easy. Figure 4.2 illustrates an example of the Navigation Toolbar used for easy navigation in the *i*ELC discussion platform. Moreover, the Student Instructional Activity Module was uploaded in individual files with small file size for easy download. On the whole, the *i*ELC discussion platform was ready for the actual study.

Figure 4.2: Example of the Navigation Toolbar

4.6 Data Collection

The following discussion draws attention the data collection process. There were several measures required before the study could be implemented in Malaysian schools. The researcher obtained approval from the Educational Planning and Research Division (EPRD) and subsequent approval from the Wilayah Persekutuan Education Department. Finally, permission was obtained from the five identified school's (1 pilot school and 2 experimental schools and 2 control schools) authorities to persuade teacher and students' cooperation. A brief outline of the study was explained verbally and relevant information such as accessibility of ICT infrastructure was acquired in exchange. The reason for this was that although most schools would have had ICT infrastructure there were no sufficient access to the Internet or teachers to supervise operation of the computer labs. In Malaysia, there is still evidence that participation in blended learning environments is conducted in computer labs rather than in classrooms, which still prove to be a major disadvantage.

When these aforementioned requirements were acquired the study proceeded with administration of the pretest. In the context of this study, the purpose of the pretest was to obtain the students' initial practice of self-regulated learning in the learning process prior to exposure to the treatment which was participation in the *i*ELC discussion platform. It

must be noted that only students in the experimental group were subjected to participation in the *i*ELC discussion platform. The pretest was only administered to the identified schools in the experimental and control groups.

The pretest was conducted from the 19th March 2007 till the 23rd March 2007, which involved the SMK. Miharja from the experimental group and the SMK. Vivekananda from the control group. An understanding was established to ensure smooth running of the pretest stage. To begin with, samples were briefed on the presence of the researcher. Students from the experimental group were briefed on the purpose of the *i*ELC discussion platform and their role of participation in it. On the other hand, students from the control group were not informed of the *i*ELC discussion platform as their participation is not required. Instructions were also given to inform the students that all information was confidential and that the scores obtained would only be computed in average mean. This was to make sure that samples were honest to their answers when responding to the instruments. Subsequently, the samples were given the instruments and asked to answer as accurately as possible. There were no questions raised by students. The samples recorded an average time of 25 minutes for answering the instrument.

The treatment was then conducted from 26th March 2007 till the 18th May 2007, which accounted for total duration of eight weeks. This length of duration was deemed sufficient by the researcher and by the supervisors of the study. In addition, the researcher also contacted Bill McKeachie, one of the authors for the MSLQ instrument, who stated that five weeks would be sufficient to measure the outcome on the practice of self-

regulated learning in the learning process. Appendix E1 contains the email correspondence between the researcher and Bill McKeachie. Hence, the duration of eight weeks for the treatment was deemed sufficient.

Again, the treatment refers to participation in the *i*ELC discussion platform with guidelines underlined by the study. Also, participation in the *i*ELC discussion platform was conducted together with the students' Form Four Physics KBSM teaching and learning process. The treatment was conducted from 26th March 2007 till the 18th May 2007, which accounted for a total duration of eight weeks. In addition, the treatment was deliberately conducted when the students were to engage in Chapter 2: Kinematics and Motion of the Form Four Physics KBSM syllabus. The reason for this was that learning for Chapter 2 required deeper comprehension of abstract concepts and more intense calculations of formulas as compared to Chapter 1 of the Form Four Physics KBSM syllabus. This decision was taken after further discussion with the respective experimental schools' teachers and the research supervisors. Moreover, getting the students to participate in the *i*ELC discussion platform with Chapter 2 of the Form Four Physics KBSM syllabus minimized the anxiety of shifting from Form Three to Form Four, and, of engaging in the Physics subject which was different from the integrated Science subject offered from Form One to Form Three. Furthermore, this allowed the students to become familiarized with the Form Four Physics KBSM subject.

The Form Four Physics KBSM subject is compulsory for all students enrolled in Science Stream in regular national secondary schools. This subject is structured with theory and

practical session, and is both conducted in the Physics Laboratory. However, several sessions were selected by the teacher to devote time to participate in *i*ELC discussion platform and these sessions were conducted in the Computer Lab. Although these periods were conducted by teachers, however, the researcher was present with the teacher and the students during the session. This was to allow the researcher to obtain qualitative data from the students and the teacher through means of semi-structured interview to support the findings of the quantitative data.

Finally, the posttest was conducted from 21st May 2007 till the 24th May 2007 involving participation of all the schools, which were SMK Miharja and SMK Aminuddin Baki from the experimental group, and SMK Vivekananda and SMK Bukit Bandaraya from the control group. The procedures of conducting the posttest were similar to the pretest.

4.7 Statistical Analyses

Subsequent to the treatment the posttest mean scores were computed and tabulated using the Statistical Package for Social Sciences (SPSS). These scores were computed and screened thoroughly to ensure there were no scores that were mistakenly entered or were out-of-range. During data screening process, missing data were identified and corrected accordingly.

In the context of this study, the two-way between-groups analysis of variance (ANOVA) was used as the statistical analyses to investigate the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning on a significant level of .05. The selection of this inferential analysis was based on the Pretest-Posttest and Posttest Only Nonequivalent Group Design (Campbell & Stanley, 1963) employed in this study. According to Pallant (2001, p. 201), "Two-way" means that there are two independent variables, and "between-groups" indicated that different people are in each of the groups. Pallant (2001) further states that this technique allows the researcher to look at individual effect and joint effect referred to as main effect and interaction effect respectively on one dependent variable. The interaction effect refers to the effect of one independent variable on a dependent variable based on the second independent variable.

The dependent variable referred to the self-regulated learning posttest mean scores. The two independent variable referred to was, first, the administration of the treatment (participation in the *i*ELC Discussion Platform) and second, the administration of the pretest. These independent variables were labeled Experimental vs. Control and Pretest vs. Non-pretest respectively. For the first independent variable, only students from the experimental group were subjected to participation in the *i*ELC Discussion Platform while student from the control group underwent only the conventional face-to-face teaching. The second independent variable is achieved through the Pretest-Posttest and Posttest Only Nonequivalent Group Design.

Accordingly, the ‘pretest’ main effect referred to the awareness of answering the pretest prior to the treatment which may affect the posttest mean scores of self-regulated learning. The ‘experimental’ main effect referred to the effect of participation in the *i*ELC discussion platform on the posttest mean scores of self-regulated learning. In the context of this study, the interaction effect referred to the effect of participation in the *i*ELC discussion platform on the posttest mean scores of self-regulated learning while taking into account the effect of the ‘pretest’ main effect.

Presentation of findings begins with descriptive results and subsequently results of inferential analysis. Descriptive analyses involved discussion on the pretest and posttest mean scores of the identified dependent variables. The purpose of descriptive analyses in this study was to summarize the acquired data and allows for a meaningful description of data. Descriptive analyses used were measures of central tendency and measures of variability. According to Gay and Airasian (2003), measures of central tendency referred to the average scores attained by the sample, while measures of variability explicate spreading of a score in a distribution.

On the other hand, Gay and Airasian (2003) establish that two-way between-groups ANOVA allows for further inferences to the identified population basing on findings from the sample. The inferential analysis results were presented in F-ratio values which were accompanied with significant and eta squared values. Significant values points out whether these effects were statistically significant, while eta squared values points out the strength of these statistically significant values.

4.7.1 Statistical Assumptions

The following discussion brings into context a series of statistical assumptions that were established prior to conducting the two-way between-groups ANOVA. Pallant (2001) points out these assumptions are as follows: level of measurement, random sampling, normal distribution and homogeneity of variance.

4.7.1.1 Level of measurement

Parametric tests such as the two-way between-groups ANOVA requires the dependent variable to be measured on an interval or ratio scale (Pallant, 2001). Given that the pretest and posttest scores for the identified dependent variables were measured on an interval scale, thus this first assumption was automatically fulfilled.

4.7.1.2 Random sampling

The second generic assumption of ANOVA was that the samples/ cases obtained must represent a random sample from the identified population (Pallant, 2001). In this study, the experimental and control groups were randomly selected from the population through a two-stage cluster sampling technique.

4.7.1.3 Homogeneity of variance

This final assumption of ANOVA posits that samples should be obtained from population of equal variances (Pallant, 2001). The Levene's test of Equality of Error Variance was conducted to test the null hypothesis that the variance of the dependent variable was

equal across groups. A non-significant value (>0.05) suggested that the variance across the groups were equal (refer to Table 5.15).

4.7.1.4 Normal distribution

Another assumption to be fulfilled was to ensure that the population from which the samples were obtained from is normally distributed (Pallant, 2001). Coakes and Steed (2000) further states that scores for each variable must be normally distributed. In this study, these assumptions were examined graphically using histogram, boxplot, normal probability plot and detrended normal plot. Pallant (2001) points out the purpose of these visual displays. Histograms present the actual shape for the distribution of scores on the continuous variable and whether it appears to be reasonably normally distributed (refer to Figure 5.1). However, Pallant (2001) also states that it is rather common to find variables in social sciences that are not normally distributed. Boxplots are used to compare distribution of scores for variables (Pallant, 2001) on the median, 25^{th} and 75^{th} percentile (Ng, 2005) (refer to Figure 5.2).

Normal probability plots (labeled Normal Q-Q Plots in SPSS output) maps out the pairing of observed value of each score against its expected value from the normal distribution (refer to Figure 5.3). Observation of a reasonably straight line indicates a normal distribution of scores. Subsequent to the normal probability plots, the detrended normal plots (labeled Detrended Normal Q-Q Plots in SPSS output) outlines the actual deviation of scores from the straight line (refer to Figure 5.4). The plot should illustrate clustering of scores around the zero line (horizontal line) without an apparent pattern.

4.7.2 Semi-structured Interview

Brief qualitative data were acquired to support the quantitative findings. Qualitative means of obtaining data allows for deeper in-context investigation on practice of self-regulated learning strategies in the learning process (Kamariah Abu Bakar, personal communication, January 11, 2007; Butler, 2002). The semi-structured interview method in particular was preferred because it allowed for suggestive data (Gillham, 2000). The semi-structured interview method begins with listening to other people's conversation (a kind of verbal observation) through the use of open and closed questions (Gillham, 2000).

It was important to point out that this thesis does not document the entire students' perception per se but rather was singled out only to support the students' perception on their most and least preferred practice of self-regulated learning strategies. Semi-structured interview questions asked were: (i) Do you like to practice this learning strategy?; (ii) Why do you prefer to practice this learning strategy?; and (iii) Why don't you practice this learning strategy?

4.8 Chapter Conclusion

This chapter discussed the research methodology employed in this study. The Pretest-Posttest and Posttest Only Nonequivalent Group Design. Discussion on this chapter also

highlighted on the research validity including the internal validity and external validity. This chapter then discussed on the instrumentation used, which was the MSLQ instrument. Discussion then continues with population and sampling, pilot study, data collection and statistical analyses used.

The following chapter will put forward the results of the study. Discussion will be channeled towards the demographic variables and, descriptive and inferential results of self-regulated learning. The chapter will conclude with the summary on the hypotheses that were rejected and failed to be rejected.

CHAPTER 5

RESULTS

The following discussion brings to attention the results of the study, which are descriptive and inferential analysis on practice of self-regulated learning through participation in the *i*ELC discussion platform. Descriptive analysis of each dependent variable was discussed according to schools in the experimental and control groups, which in deliberate order are SMK Miharja, SMK Vivekananda, SMK Aminuddin Baki and SMK Bukit Bandaraya. Discussion on inferential analysis refers to the two-way between-groups analysis of variance conducted only on self-regulated learning posttest mean scores.

5.1 Demographic Variables

The following discussion brings to attention the demographic variables of the study. The demographic variables measured in the study were gender, computer ownership, time duration in using a computer, availability of the Internet access at home, frequency of accessing the Internet in a day, frequency of revising the Form Four Physics KBSM subject and frequency of accessing the Internet for purposes of revising the Form Four Physics KBSM subject.

Findings indicated that there were 53 male students and 49 female students, giving a total of 102 students participating in the study. Out of these students, 50 students accounted for the experimental group and the remaining 52 students accounted for the control group. For the experimental group, there were 23 male students and 27 female students. For the control group, there were 30 male students and 22 female students. Table 5.1 presents the frequency of male and female students for the experimental and control groups.

Table 5.1: Frequency of gender

	Male	**Female**	**Total**
Experimental	23	27	50
Non-experimental	30	22	52
Total	53	49	102

To account for computer ownership, 93 students indicated that they owned a computer at home while only nine students indicated that they did not own a computer at home. Out of the 50 students in the experimental group, 49 students indicated that they owned a computer at home while only one student indicated that he/ she did not owned a computer at home. Out of the 52 students in the control group, 44 students indicated that they own a computer at home while eight students indicated that they did not own a computer at home. Table 5.2 presents the frequency of computer ownership.

Table 5.2: Frequency of computer ownership

	Yes	No	Total
Experimental	49	1	50
Control	44	8	52
Total	93	9	102

To account for the number of years the students in the experimental group have been using the computer, the highest frequency (n = 10) referred to students who have been using the computer for six years, while the lowest frequency (n = 2) referred to students who have been using the computer for ten years. To account for the number of years the students in the control group have been using the computer, the highest frequency (n = 11) referred to students who have been using the computer for five years, while the lowest frequency (n = 2) referred to students who have been using the computer for eight and ten years respectively. Table 5.3 presents the frequency of years on the students using the computer.

To account for the availability of the Internet access at home for students in the experimental group, forty-one students indicated that they have the Internet access at home, while nine students indicated that they did not have the Internet access at home. To account for the availability of the Internet access at home for students in the control group, forty-two students indicated that they have the Internet access at home, while ten students indicated that they did not have the Internet access at home. Table 5.4 presents the frequency on the availability of the Internet access at home.

Table 5.3: Frequency of years using the computer

Number of years	Frequency	
	Experimental	**Control**
1	4	4
2	4	6
3	4	6
4	6	5
5	9	11
6	10	8
7	4	5
8	4	2
9	3	3
10	2	2
Total	50	52

Table 5.4: Frequency for the availability of the Internet access at home

	Yes	**No**	**Total**
Experimental	41	9	50
Control	42	10	52
Total	83	19	102

To account for the frequency of accessing the Internet in a day for students in the experimental group, fourteen students indicated that they always accessed the Internet in a day. To account for the frequency of accessing the Internet in a day for students in the control group, only ten students indicated that they always get accessed to the Internet in

a day. In total, the majority of students (n = 30) only 'often' accessed the Internet in a day. Table 5.5 presents the students' frequency of accessing the Internet in a day.

Table 5.5: Frequency of accessing the Internet in a day

	Never	Seldom	Often	Frequently	Always	Total
Experimental	2	3	16	15	14	50
Control	5	9	14	14	10	52
Total	7	12	30	29	24	102

To account for the frequency of revising the Form Four Physics KBSM subject, only two students in both the experimental and control groups always revised the subject. However, the majority of students in the experimental group (n = 18) and in the control group (n = 21) indicated that they often revised the subject. Table 5.6 presents the frequency of students' revising the Form Four Physics KBSM subject.

Table 5.6: Frequency of revising the Form Four Physics KBSM subject

	Never	Seldom	Often	Frequently	Always	Total
Experimental	10	13	18	7	2	50
Control	9	14	21	6	2	52
Total	19	27	39	13	4	102

To account for the frequency of accessing the Internet for purposes of revising the Form Four Physics KBSM subject, thirty-one students from the experimental group and twenty-seven students from the control group indicated that these students never accessed

the Internet for purposes of revising the Form Four Physics KBSM subject. Table 5.7 presents the frequency of accessing the Internet for purposes of revising the Form Four Physics KBSM subject.

Table 5.7: Frequency of accessing the Internet for revising the Form Four Physics KBSM subject

	Never	Seldom	Often	Frequently	Always	Total
Experimental	31	17	2	0	0	50
Control	27	15	9	1	0	52
Total	58	32	11	1	0	102

5.2 Self-Regulated Learning

5.2.1 Descriptive Analysis

Discussions on the descriptive analysis of self-regulated learning were described based on the motivation and learning strategies scales of the Motivated Strategies for Learning Questionnaire (MSLQ).

5.2.1.1 Motivation Scale

In the context of this study, the Motivation Scale consisted of four subscales, which were Intrinsic Goal Orientation, Extrinsic Goal Orientation, Control Beliefs and Self-Efficacy for Learning and Performance. Subsequent discussions refer to the results presented in Table 5.8.

For the motivation pretest mean scores result for SMK Miharja, the Control of Learning Beliefs subscale recorded the highest mean value of 23.00 (SD = 5.88) among the other Motivation subscales. This was followed with the Extrinsic Goal Orientation and Self-Efficacy for Learning and Performance subscales with mean values and standard deviation values of 22.81 (SD = 6.23) and 16.71 (SD = 7.38) respectively. The Intrinsic Goal Orientation subscale recorded the lowest mean value of 14.90 (SD = 3.96). For the motivation posttest mean scores result, the Extrinsic Goal Orientation subscale registered the highest mean value of 19.71 (SD = 6.56). The Control of Learning Beliefs subscale recorded the second highest mean value of 19.05 (SD = 5.95). This was followed by the Self-Efficacy for Learning and Performance subscale with a mean value of 17.19 (SD = 5.76). The Intrinsic Goal Orientation noted the lowest mean value of 13.00 (SD = 4.15). However, despite the mean values mentioned above, only the Self-Efficacy for Learning and Performance subscale managed an increase of 0.48 in mean value from the pretest result. The Intrinsic Goal Orientation, Extrinsic Goal Orientation and Control of Learning Beliefs subscales recorded a decrease of 1.90, 3.10 and 3.95 in mean values respectively from the pretest.

For the motivation pretest mean scores result for SMK Vivekananda, the Extrinsic Goal Orientation subscale recorded the highest mean value of 23.96 (SD = 3.82) among other Motivation subscales. This was followed with the Control of Learning Beliefs and Self-Efficacy for Learning and Performance subscales with mean values and standard deviation values of 23.87 (SD = 4.45) and 23.04 (SD = 4.62) respectively. The Intrinsic Goal Orientation subscale recorded the lowest mean value of 16.91 (SD = 4.12). For the

motivation posttest mean scores result, both the Extrinsic Goal Orientation and Control of Learning Beliefs subscales recorded the highest mean value of 21.83 (SD = 4.93, 4.60). The Self-Efficacy for Learning and Performance subscale continued closely with a mean value of 20.48 (SD = 5.32). Again, the Intrinsic Goal Orientation noted the lowest mean value of 15.57 (SD = 3.60). The posttest results for SMK Vivekananda also experienced decrease in mean values. Only the Intrinsic Goal Orientation subscale noted the smallest decrease of 1.34 in mean value. The Control of Learning Beliefs and Extrinsic Goal Orientation registered decrease of 2.04 and 2.13 in mean values respectively. Unlike SMK Miharja result, the Self-Efficacy for Learning and Performance subscale recorded the highest decrease of 2.56 in mean value.

Pretests mean scores result was not applicable to SMK Aminuddin Baki given that this school was not subjected to the pretest. This was based on random assignment of schools to the pretest and non-pretest groups as underlined by the Pretest-Posttest and Posttest Only Nonequivalent Group Design adopted by the study. For the motivation posttest results, both the Extrinsic Goal Orientation and Control of Learning Beliefs subscales attained the highest mean value of 23.79 (SD = 5.60, 5.19). The Self-Efficacy for Learning and Performance subscale noted a mean value of 17.45 (SD = 6.90). The Intrinsic Goal Orientation subscale recorded the lowest mean value of 15.17 (SD = 3.78). Comparison of pretest and posttest mean values was not applicable given that the school was not subjected to a pretest.

The pretests mean scores result were again not applicable to SMK Bukit Bandaraya given that this school was not subjected to the pretest. This was also based on random assignment of schools to the pretest and non-pretest groups as underlined by the Pretest-Posttest and Posttest Only Nonequivalent Group Design adopted by the study. For the motivation posttest results, the Extrinsic Goal Orientation subscale recorded the highest mean value of 21.34 (SD = 4.79). This was followed by the Control of Learning Beliefs and Self-Efficacy for Learning and Performance subscales with mean values of 20.48 and 18.72 (SD = 4.90, 6.25). The Intrinsic Goal Orientation recorded the lowest mean value of 13.79 (SD = 3.47). Again, comparison of pretest and posttest mean values was not applicable given that the school was not subjected to a pretest.

The following paragraph discusses on descriptive analysis between experimental and control groups as shown in Table 5.9. This comparison of mean scores results between experimental and control groups would give a general idea on the effectiveness of participation in the *i*ELC discussion platform in advancing the practice of self-regulated learning.

For the posttests result in the experimental group, the Extrinsic Goal Orientation subscale recorded the highest mean value of 22.08 (SD = 6.29). This was followed by the Control of Learning Beliefs and Self-Efficacy for Learning and Performance with mean values of 21.80 and 17.34 (SD = 5.95 and 6.39). The Intrinsic Goal Orientation subscale recorded the lowest mean value of 14.26 (SD = 4.04). For the posttests results in the control group, the Extrinsic Goal Orientation subscale again recorded the highest sum of mean value of

21.56 (SD = 4.81), and subsequently the Control of Learning Beliefs subscale with the mean value of 21.08 (SD = 4.77). The Self-Efficacy for Learning and Performance subscale recorded a mean value of 19.50 (SD = 5.87), while the Intrinsic Goal Orientation subscale recorded the lowest mean value of 14.67 (SD = 3.58).

Descriptive results in Table 5.9 also brings into context the most practiced and the least practiced subscales used by both the experimental schools during participation in the *i*ELC discussion platform. The reason for this comparison was to determine the types of motivation strategies practised by students while engaging in a hybrid learning process. The most practiced type of motivation strategy was the Extrinsic Goal Orientation while the least practiced type of motivation strategy was the Intrinsic Goal Orientation.

Table 5.9: Motivation Scale posttest results for the experimental and control groups

	Experimental Group Mean (SD)	**Control Group Mean (SD)**
Intrinsic Goal Orientation	14.26 (4.04)	14.67 (3.58)
Extrinsic Goal Orientation	22.08 (6.29)	21.56 (4.81)
Control of Learning Beliefs	21.80 (5.95)	21.08 (4.77)
Self-Efficacy for Learning and Performance	17.34 (6.39)	19.50 (5.87)

As to the presentation of posttest results for the experimental and control groups, the discussion for the pretest and non-pretest groups would also look into mean values attained by each subscale of the Motivation Scale. However, the purpose on the presence of pretest and non-pretest groups was to determine whether the motivation posttests result were influenced by administration of the pretest prior to the treatment. There appears to be only very small differences in mean values between pretest and non-pretest groups. The Intrinsic Goal Orientation subscale recorded the lowest difference of 0.23 in mean value while the Extrinsic Goal Orientation subscale recorded the highest difference of 1.75 in mean value. The Control of Learning Beliefs and Self-Efficacy for Learning and Performance subscale noted differences of 1.64 and 0.82 in mean value. Table 5.10 presents the Motivation scale posttest mean scores between the pretest and non-pretest groups.

Table 5.10: Motivation Scale posttest results for the pretest and non-pretest groups

	Pretest Group Mean (SD)	**Control Group Mean (SD)**
Intrinsic Goal Orientation	14.34 (4.04)	14.57 (3.65)
Extrinsic Goal Orientation	20.82 (5.80)	22.57 (5.31)
Control of Learning Beliefs	20.50 (5.41)	22.14 (5.27)
Self-Efficacy for Learning and Performance	18.91 (5.73)	18.09 (6.55)

5.2.1.2 Learning Strategies Scale

The preceding discussion highlighted on descriptive analysis of the Motivation Scale. The subsequent discussion highlights on descriptive analysis of the Learning Strategies Scale (refer to Table 5.11). In the context of this study, the Learning Strategies Scale consists of nine subscales, which were Rehearsal, Elaboration, Organization, Critical Thinking, Metacognitive Self-Regulation, Time and Study Environment, Effort Regulation, Peer Learning and Help Seeking.

For the learning strategies pretest mean scores result for SMK Miharja, the Elaboration subscale recorded the highest mean value of 27.17 (SD = 8.39) among the other Learning Strategies subscales. The Time and Study Environment, Help Seeking, Effort Regulation, Metacognitive Self-Regulation, Organization, Rehearsal and Peer Learning subscales registered mean values of 18.33, 18.19, 17.95, 13.38, 13.29, 11.00 and 10.38 (SD = 4.07, 6.06, 3.15, 3.89, 4.48, 3.66 and 3.40). The Critical Thinking subscale recorded the lowest mean value of 10.05 (SD = 3.79).

For the motivation posttest mean scores result, the Elaboration subscale registered the highest mean value of 34.14 (SD = 7.88) among the other Learning Strategies subscales. About ten scores behind, the Help Seeking subscale recorded the second highest mean value of 23.81 (SD = 6.14). This was followed closely by the Time and Study Environment subscale with mean value of 22.71 (SD = 3.68). The Effort Regulation, Organization, Rehearsal, Metacognitive Self-Regulation and Peer Learning subscales

noted mean values of 20.29, 19.96, 17.62, 16.48 and 14.95 (SD = 3.64, 5.17, 3.23, 4.56 and 3.07). The Critical Thinking subscale registered the lowest mean value of 14.76 (SD = 2.02).

The following discussion draws attention to the highest increase in mean values from the pretest to the posttest mean scores results. Among the nine learning strategies scales, the Organization subscale took the lead with the highest increase of 6.67 in mean value. This was closely followed with the Rehearsal and Elaboration subscales with an increase of 6.62 and 6.43 in mean value respectively. The subsequent subscales were Help Seeking, Critical Thinking, Peer Learning, Time and Study Environment, and Metacognitive Self-Regulation with an increase of 5.62, 4.71, 4.57, 4.38, and 3.10 in mean value respectively. The Effort Regulation subscale had the lowest increase of only 2.34 in mean value.

This descriptive analysis presents a two-fold perspective in developing learning strategies through participation in the *i*ELC discussion platform. First, the subscale that had the highest in the posttest mean value among the other subscales indicated the types of learning strategies students employed during participation in the *i*ELC discussion platform. These were Elaboration, Help Seeking and Time and Study Environment strategies. Second, increase in mean values from the pretest to the posttest points out the learning strategies that were better developed during participation in the *i*ELC discussion platform. The top three learning strategies that students developed better were Organization, Rehearsal and Elaboration strategies.

For the learning strategies mean scores result for SMK Vivekananda, the Elaboration subscale recorded the highest mean value of 28.91 (SD = 8.90). The Help Seeking, Time and Study Environment, Organization, Effort Regulation and Metacognitive Self-Regulation subscales recorded mean values of 22.00, 20.04, 15.65, 15.00 and 14.91 (SD = 4.11, 4.80, 4.26, 3.38 and 3.29). The Peer Learning and Rehearsal subscales registered matching mean values of 13.17 but with different standard deviation values of 3.65 and 5.00 respectively. The Critical Thinking subscale recorded the lowest mean value of 11.61 (SD = 3.76).

For the learning strategies posttest mean scores result, the Elaboration subscale recorded the highest mean value of 31.57 (SD = 9.24). The Help Seeking subscale recorded the second highest mean value of 21.43 (SD = 5.26). The Time and Study Environment subscale registered the third highest mean value of 19.22 (SD = 4.74). The Metacognitive Self-Regulation subscale took in a close lead with a mean value of 18.04 (SD = 4.55). The Organization, Effort Regulation, Rehearsal and Critical Thinking recorded mean values of 16.83, 15.09, 13.00 and 12.35 (SD = 6.12, 2.33, 4.35, 3.83). The Peer Learning subscale noted the lowest mean value of 11.52 (SD = 2.87).

The pretests mean scores result was not applicable to SMK Aminuddin Baki given that this school was not subjected to the pretest. For the learning strategies posttest mean scores result, the Elaboration subscale recorded the highest mean value of 33.55 (SD = 9.16). The Help Seeking subscale continued with the second highest mean value of 24.48 (SD = 6.46). The Effort Regulation subscale noted a mean value of 23.38 (SD = 2.99).

The Time and Study Environment subscale had a mean value of 23.24 (SD = 3.65). The Organization and Metacognitive Self-Regulation subscales were in close competition with means values of 19.69 and 19.38 (SD = 4.87, 4.48). The order was continued with the Rehearsal and Peer Learning subscales with mean values of 17.17 and 15.79 (SD = 3.68, 3.34). The Critical Thinking subscale registered the lowest mean value of 15.38 (SD = 3.81).

The following discussion brings into context the most practiced and least practiced subscales used by both the experimental schools during participation in the *i*ELC discussion platform. The reason for this comparison was to determine the types of learning strategies most practiced by students while engaging in a blended learning process. The top three types of learning strategies most practiced by students in SMK Miharja were Elaboration, Help Seeking and Time and Study Environment, while for SMK Aminuddin Baki were Elaboration, Help Seeking and Effort Regulation. On the other hand, the top three types of learning strategies least practiced by students in SMK Miharja were Metacognitive Self-regulation, Peer Learning and Critical Thinking, while for SMK Aminuddin Baki were Rehearsal, Peer Learning and Critical Thinking.

Pretest mean scores result was not applicable to SMK Bukit Bandaraya given that this school was not subjected to the pretest. For the learning strategies posttest mean scores result, the Elaboration subscale noted the highest mean value of 27.93 (SD = 9.28). The Help Seeking subscale recorded the second highest mean value of 19.34 (SD = 6.65). The Time and Study Environment subscale registered the third highest mean value of 17.41

(SD = 3.57). In close lead, the Effort Regulation subscale recorded a mean value of 16.48 (SD = 4.15). The Metacognitive Self-Regulation, Organization, Rehearsal and Peer Learning subscales recorded mean values of 15.34, 14.28, 11.52 and 10.69 (SD = 5.35, 4.74, 3.92, 3.58). The Critical Thinking registered the lowest mean value of 10.24 (SD = 4.23).

The following discussion gives details to the overall mean and standard deviation values for experimental and control groups as presented in Table 5.12. The table presents the Learning Strategies Scale posttest means score results between the experimental and control groups. For the posttest mean scores in the experimental group, the Elaboration subscale recorded the highest mean value of 33.80 (SD = 8.57). This was followed by the Help Seeking subscale with the mean value of 24.20 (SD = 6.27) and the Time and Study Environment subscale with 23.02 (SD = 3.63). The order of the subscales was continued with Effort Regulation, Organization, Metacognitive Self-Regulation, Rehearsal and Peer learning with mean values of 22.08, 19.80, 18.16, 17.36 and 15.44 (SD = 3.59, 4.95, 4.69, 3.47, 3.23). The Critical Thinking subscale registered the lowest mean value of 15.12 (SD = 3.17).

For the control group, the Elaboration subscale again achieved the highest mean value of 29.54 (SD = 9.35). This was again followed with the Help Seeking subscale and the Time and Study Environment subscale with mean values of 20.27 and 18.21 (SD = 6.11, 4.18). The order of the subscales was continued with Metacognitive Self-Regulation, Effort Regulation, Organization, Rehearsal and Critical Thinking with mean values of 16.54,

15.87, 15.40, 12.17 and 11.17 (SD = 5.15, 3.50, 5.49, 4.14, 4.16). The Peer Learning subscale recorded the lowest mean value of 11.06 (SD = 3.28).

Table 5.12: Learning Strategies Scale posttest mean score results for the experimental and control groups

Subscales	**Experimental Group Mean (SD)**	**Control Group Mean (SD)**
Rehearsal	17.36 (3.47)	12.17 (4.14)
Elaboration	33.80 (8.57)	29.54 (9.35)
Organization	19.80 (4.95)	15.40 (5.49)
Critical Thinking	15.12 (3.17)	11.17 (4.16)
Metacognitive Self-Regulation	18.16 (4.69)	16.54 (5.15)
Time and Study Environment	23.02 (3.63)	18.21 (4.18)
Effort Regulation	22.08 (3.59)	15.87 (3.50)
Peer Learning	15.44 (3.23)	11.06 (3.28)
Help Seeking	24.20 (6.27)	20.27 (6.11)

The following discussion presents a comparison of mean scores result between pretest and non-pretest groups. To reiterate, the purpose on the presence of pretest and non-pretest groups was to determine whether the learning strategies posttests result were influenced by administration of the pretest prior to the treatment. Table 5.13 presents the Learning Strategies Scale posttest mean score results between the pretest and non-pretest groups.

Table 5.13: Learning Strategies Scale posttest mean score results for the pretest and non-pretest groups

Subscales	**Pretest Mean (SD)**	**Non- pretest Mean (SD)**
Rehearsal	15.20 (4.47)	14.31 (4.67)
Elaboration	32.80 (8.62)	30.74 (9.57)
Organization	18.32 (5.84)	16.98 (5.49)
Critical Thinking	13.50 (3.30)	12.81 (4.76)
Metacognitive Self-Regulation	17.30 (4.57)	17.36 (5.30)
Time and Study Environment	20.89 (4.57)	20.33 (4.63)
Effort Regulation	17.57 (3.98)	19.93 (4.99)
Peer Learning	13.16 (3.41)	13.24 (4.29)
Help Seeking	22.57 (5.76)	21.91 (7.00)

5.2.2 Inferential Analysis

The following discussion draws attention to the two-way between-groups analysis of variance (ANOVA) on posttest mean scores of self-regulated learning. In the discussion of descriptive analyses, self-regulated learning was discussed separately on the Learning Strategies Scale and Motivation Scale. This was to allow for comparison of mean and standard deviation values between the experimental and control groups. However, discussion on inferential analysis will be based on self-regulated learning as a single dependent variable. This was because self-regulated learning was constructed of both learning strategies and motivation (Pintrich et al., 1991). The assumptions on the two-way between groups ANOVA was satisfied and reported in section 4.7.1 on "Statistical Assumptions"

However, the ensuing discussion highlights on statistical assumptions that must be satisfied before the two-way between-groups ANOVA can be conducted. Violation of these assumptions may imply inaccuracy in interpretation of the treatment.

Assumption of normal distribution states that the population from which the samples were obtained from is normally distributed (Pallant, 2001). The Kolmogorov-Smirnov statistic tests the hypothesis that the data are normally distributed. A high significance value (usually more than .05) indicates that the distribution of data does not differ significantly from a normal distribution (Coakes & Steed, 2000). Ng (2005) and Pallant

(2001) asserts that the null hypothesis needs to be tested to determine the selection of the sample from a normally distributed population.

The following null hypothesis (H_0) was tested:

H_0: The sample was selected from a normally distributed population

H_a: The sample was not selected from a normally distributed population

From the Kolmogorov-Smirnov Test of normality, the observed significant value of .200 obtained was greater than .05. Thus, the test fails to reject the null hypothesis (H_0), which posits that the sample was selected from a normally distributed population. Table 5.14 depicts the Kolmogorov-Smirnov Test of Normality for self-regulated learning.

Table 5.14: Kolmogorov-Smirnov Test of Normality for self-regulated learning

	Kolmogorov-Smirnov		
	Statistic	**df**	**Sig.**
Self-Regulated Learning	.072	102	.200

Histogram, boxplot, normal probability plot and detrended normal plot were also used to examine the normally distributed population assumption graphically. For the histogram, the values on the horizontal axis indicated the posttest scores for the self-regulated learning variable. The lowest self-regulated learning posttest score was 125 while the maximum score was 350. The values on the vertical axis indicated the frequency of these posttest scores. The lowest frequency score was 1 while the highest frequency score was

12. The shape of the distribution was reasonably distributed as illustrated the histogram for self-regulated learning in Figure 5.1. In such cases, scores usually occur in the centre and was tapered out towards the extremes (Ng, 2005). The distribution reads a slightly negatively skewed value (skewness = -.10), and thus do not require transformation of data (Pallant, 2001). The reason is that variables in social science studies seldom measure up to a typical normal distribution (Pallant, 2001). The boxplot shows more information concerning the actual values in the distribution, which were not represented by the histogram. Figure 5.2 depicts the boxplot of the self-regulated learning scores. Careful analysis of the boxplot will identify the presence of extreme scores that may cause digression on the interpretation of the self-regulated learning posttest scores. Hence, the boxplot is used to determine whether or not it is necessary to delete the presence of this extreme score. However, the boxplot indicated that there is no presence of any extreme scores. Subsequently, the normality probability plot was used to observe the pairing of each observed value with its expected value from the normal distribution of scores (Ng, 2005; Pallant, 2001). Values that follow along the straight line indicate a normal distribution of scores (Ng, 2005; Pallant, 2001). Figure 5.3 clearly indicated that the self-regulated learning posttest scores follow a normal distribution. The detrended normal plot calculates the actual deviation of the values from a straight line (Ng, 2005; Pallant, 2001). Figure 5.4 depicts the detrended normal plot of self-regulated learning posttest mean scores. In this plot, values that cluster in the region of the horizontal line marked at zero suggest normality of scores (Pallant, 2001; Coakes & Steed, 2000), as is the case for the self-regulated learning posttest mean scores.

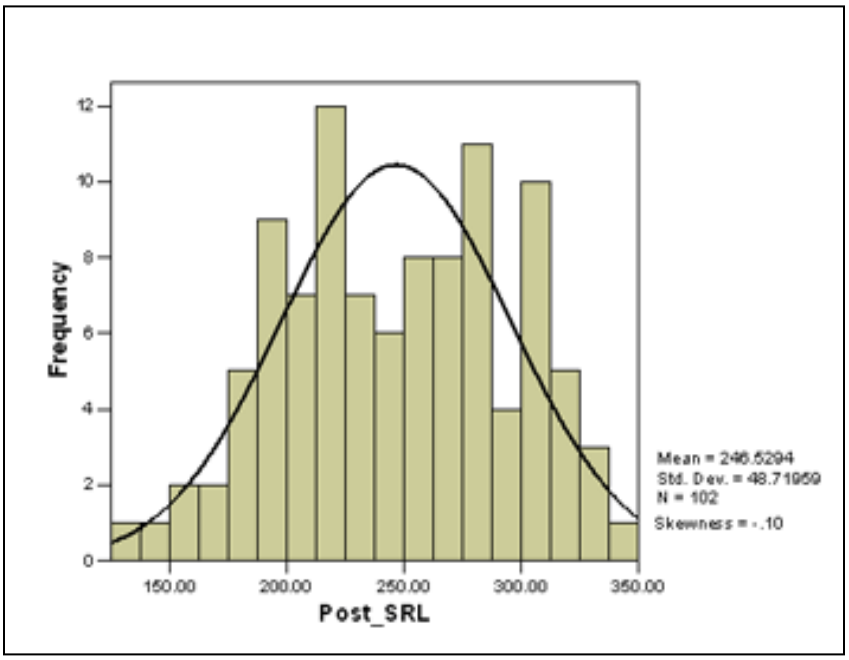

Figure 5.1: Histogram of self-regulated learning

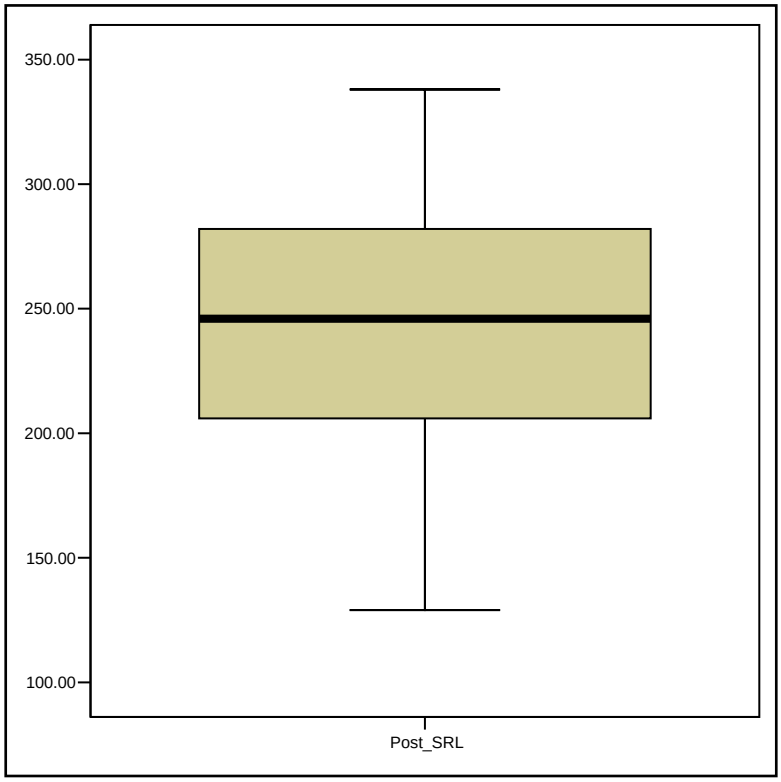

Figure 5.2: Boxplot of self-regulated learning

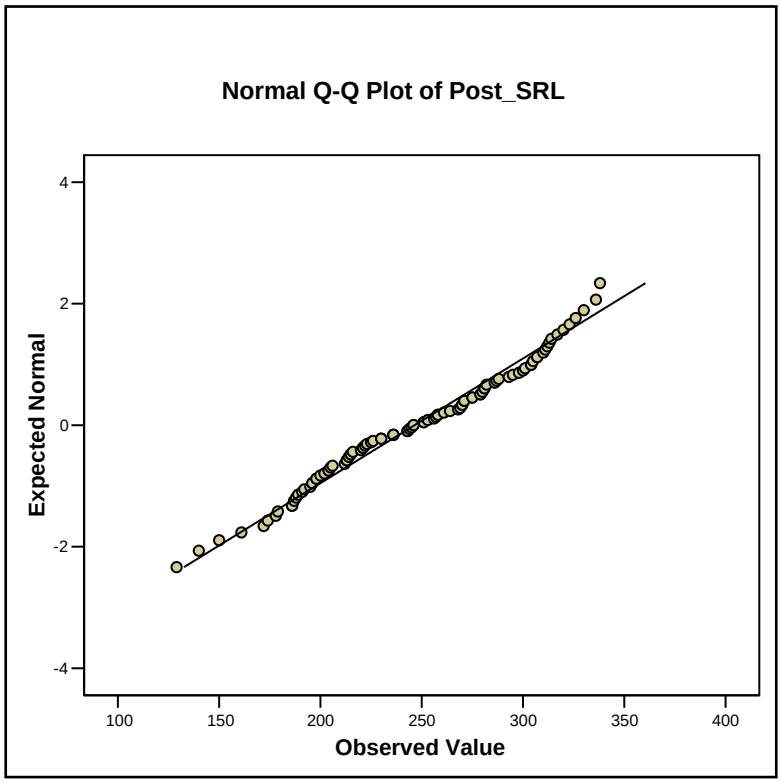

Figure 5.3: Normality probability plot for self-regulated learning

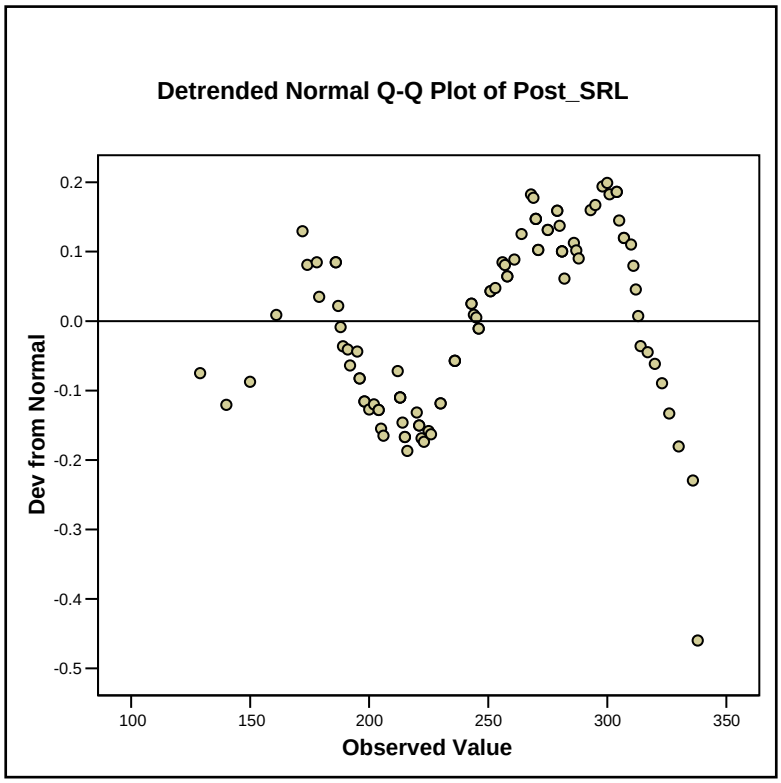

Figure 5.4: Detrended normal plot for self-regulated learning

The assumption on homogeneity of variances self-regulated learning posttest mean scores was tested using the Levene's test of equality of error variances, as depicted in Table 5.15. In the context of this study, the null hypothesis (H_0) was tested to determine if the self-regulated learning posttests mean scores variance was equal across both the experimental and control groups which have been subjected to the intervention and/ or the pretest.

The following null hypothesis (H_0) was tested:

H_0: The self-regulated learning posttests mean scores variance was equal across the groups

H_a: The self-regulated learning posttests mean scores variance was not equal across the groups

The obtained significant value of .302 is greater than .05, which suggested that the null hypothesis (H_0) failed to be rejected. Thus, the assumption was satisfied that the self-regulated learning posttests mean scores variance was equal across the groups.

Table 5.15: Levene's Test of Equality of Error Variances for self-regulated learning posttest mean scores

F	df1	df2	Sig.
1.233	3	98	.302

The two-way between-groups ANOVA was conducted on the .05 level of significance to determine the second objective of the study, which was to investigate the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning strategies in

the learning process. The objective of the study consisted of three hypotheses that had to be tested. These identified hypotheses were formulated based on literature reviews and the Pretest-Posttest and Posttest Only Nonequivalent Group Design adopted in the study. Table 5.16 presents the two-way between-groups ANOVA inferential analysis for self-regulated learning.

H1: There was a significant testing main effect between the pretest and non-pretest groups on self-regulated learning posttest mean scores

H2: There was a significant treatment main effect between the experimental and control groups on self-regulated learning posttest mean scores

H3: There was a significant interaction effect between the testing effect and treatment effect on self-regulated learning posttest mean scores

Table 5.16: Two-way between-groups ANOVA for self-regulated learning

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Eta Squared**
Experimental	34985	1	34985	17.92	<.0005	.16
Pretest	288	1	288	.15	.70	.00
Experimental * Pretest	7726	1	7726	3.96	.05	.04
Error	191336	98	1952			
Total	6438962	102				

To account of the first hypothesis, findings of inferential analysis indicated that there was no significant main effect between the pretest and non-pretest groups [$F(1, 98) = .15$, $p = .70$]. As pointed out by the guidelines by Cohen (1988), the magnitude of this effect was small (eta squared = .00). This implied that the pretest and non-pretest groups did not significantly differ in terms of their self-regulated learning posttest mean scores. To account for the second hypothesis, findings of inferential analysis indicated that there was a significant main effect between the experimental and control groups [$F(1, 98) = 17.92$, $p < .0005$] with a large effect size (eta squared = .16) (Pallant, 2001). This implied that the experimental and control groups differed significantly in terms of their self-regulated learning posttest mean scores. To account for the third hypothesis, findings of inferential analysis indicated that there was no significant interaction effect between the experimental groups and the pretest groups [$F(1, 98) = 3.96$, $p = .05$]. This implied that there was no significant difference in the effect of treatment (experimental and control groups) on self-regulated learning posttest mean scores for the pretest and non-pretest groups.

5.3 Summary on the Acceptance and Rejection of Hypotheses

The following discussion forwards a summary on the acceptance or rejection of the hypotheses of the study based on the results of the two-way between-groups ANOVA. Table 5.17 presents the summary on the status of the hypotheses.

Table 5.17: Summary on the status of hypotheses

Objective 2: To investigate the effectiveness of the proposed *i*ELC discussion platform in advancing self-regulated learning strategies in the learning process		
H1:	There was a significant testing main effect between the pretest and non-pretest groups on self-regulated learning posttest mean scores	Reject
H2:	There was a significant treatment main effect between the experimental and control groups on self-regulated learning posttest mean scores	Fail to Reject
H3:	There was a significant interaction effect between the testing effect and treatment effect on self-regulated learning posttest mean scores	Fail to Reject

5.4 Chapter Conclusion

This chapter puts forward the results of the study. The two-way between-groups ANOVA was used to analyze the self-regulated learning scores. The results were discussed according to the demographic variables and, self-regulated learning descriptive and inferential analyses results.

The following chapter will put forward the discussion based on the results of this study. The discussion is supported with references and theories used in Chapter 2 “Literature Review”.

CHAPTER 6

DISCUSSIONS

The objectives of the study were twofold. The first objective was to develop the *i*ELC discussion platform. This objective was achieved and outlined in Chapter 3 with discussions on the *i*ELC project management. The second objective was to investigate the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning strategies in the learning process. The second objective was determined through descriptive and inferential analysis of the two-way between-groups analysis of variance (ANOVA). The chapter begins discussion of findings on self-regulated learning.

6.1 Participation in the *i*ELC Discussion Platform vs. Traditional Teaching and Learning Approach

In the context of this study, the findings indicated that participation in the *i*ELC discussion platform was more effective in encouraging practice of self-regulated learning strategies compared to the traditional teaching and learning method. The descriptive and inferential findings of the study supports that participation in the *i*ELC discussion platform led to better involvement in the learning process compared to the traditional teaching and learning method. Thus were the reasons why learning through means of online learning is now more popular among academic institutions (Picciano, 2006; Reece & Lockee, 2005). Numerous researches also indicated that a blended learning approach

yields the advantages of both online learning and the classroom approach, and at the same time reduces the disadvantages of both these approach (Hysong & Mannix, 2003; Verma, 2002; Masie, 2002).

Comparative studies among the classroom, blended and online approach on the amount of knowledge acquisition have found that students were the most actively involved in acquiring knowledge in a blended learning environment compared to the other approach. Another recent study by Sitzmann, Kraiger, Stewart and Wisher (2006) reported findings that strongly suggested that participating in a blended learning environment was effective in acquiring declarative and procedural knowledge. Knowles (1990) found that participating in blended learning environment fosters increased practice of learner control and independent learning. Moreover, students engaged in a blended learning environment were able to improve communication between peers, develops understanding of subject content and increase revision of the subject content (Osguthorpe & Graham, 2003).

6.2 Discussion of Findings on Self-Regulated Learning

In this study, the conceptual understanding of self-regulated learning was based on the definition by Pintrich and his colleagues. Self-regulated learning justifies how students metacognitively, motivationally and behaviorally improve their individual academic achievement by exercising various learning strategies (Pintrich et al., 1991). The self-regulated learning scores were measured using the Motivated Strategies for Learning

Questionnaire (MSLQ), which consisted of the Motivation Scale and the Learning Strategies Scale.

On the whole, results indicated that the average student's practice of self-regulated learning through participation in the *i*ELC discussion platform was higher than the average student's practice of self-regulated learning through the traditional teaching and learning method. This finding implied that participation in the *i*ELC discussion platform yields better practice of self-regulated learning strategies compared to participation in a traditional teaching and learning environment.

This increase in the practice of self-regulated learning strategies may be explained by Dabbagh and Kitsantas (2004) who argued that participation in online learning environment encouraged further practice of self-regulatory competence to accomplish the identified learning goals, which was not so evident in traditional learning environment when the teacher dominated significantly over the teaching and learning process. For instance, practice of the organization and help seeking strategies were more evident in the *i*ELC discussion platform as compared to the traditional learning environment. To reiterate, students' participation in the forums, chat and dialogue sessions were conducted through means of the Internet in the *i*ELC discussion platform.

The reason for this improved practice of self-regulated learning strategy can be explained by the occurrence of student autonomy in the learning process (Kinzie, 1990) which was not normally the case with the traditional learning environment. Kinzie (1990) further

argues that this occurrence of student autonomy can be justified with the physical absence of the teacher (Kinzie, 1990).

The following discussion highlights on the subscales of self-regulated learning. Discussion begins with findings obtained from the Motivation Scale which then continues with findings obtained from the Learning Strategies Scale.

6.2.1 Findings from the Motivation Scale

Good practices of motivation possess the propensity to provoke the process of learning (Schunk, 1991). Results of the Motivation Scale indicated that respondents in both experimental and control groups exhibited low levels of motivation. However, respondents in the experimental group showed slightly higher level of motivation than respondents in the control group. Comparison of mean values between experimental and control groups on the practice of the motivation strategies suggests that students who participated in the *i*ELC discussion platform showed higher motivation levels as compared to the students in the traditional learning environment.

However, qualitative data were acquired through means of semi-structured interview to investigate and support these quantitative findings on practice of motivation. When students were enquired generally on their low practice of motivation the students indicated that the Form Four Physics KBSM subject was new to them and it was different from the integrated Science subject that was offered in lower secondary. The students

also indicated they need for time to be familiarized with the subject. These qualitative findings support the arguments of Schunk (1991) who indicated that there exists a give-and-take relationship between learning and performance. That is, the complexity of a subject affects the motivation on varying levels. The fact that the Physics KBSM subject was new to these Form Four students and given the complexity of the subject evidently suggested poor practice of motivation. However, it must be taken into account that comparison of mean values between experimental and control groups suggested that students who participated in the *i*ELC discussion platform showed higher motivation levels as compared to the students in the traditional learning environment.

The following discussion would highlight the descriptive analyses on Motivation Scale in their respective subscales to allow for a better understanding on the practice of motivation. Results of descriptive analysis clearly suggested a twofold view in practicing the motivational subscales. First, high posttests mean scores indicated the practice of the motivation subscales that were applied in the learning process. Second, increase in mean scores from the pretest to posttest suggested the motivation subscales that were improved during participation in the *i*ELC discussion platform.

Based on descriptive statistics of the experimental group, the Extrinsic Goal Orientation subscale recorded the highest posttest mean value and was followed by the Control of Learning Beliefs subscale. On the other hand, the Intrinsic Goal Orientation recorded the lowest posttest mean value. On the other hand, descriptive statistics of the control group from Table 5.9 showed that the Extrinsic Goal Orientation subscale recorded the highest

mean value and subsequently the Control of Learning Beliefs subscale with the mean value. This was followed with the Self-Efficacy for Learning and Performance and the Intrinsic Goal Orientation subscales.

This finding implied that a majority of students who participated in the *i*ELC discussion platform reflected strong extrinsic goal orientation subscale. Practice of extrinsic goal orientation indicated that students necessitated their learning process on external reasons such as grades, rewards, performance, evaluation, competition, to prove one's ability (Sungur & Tekkaya, 2006; Pintrich et al., 1991), to avoid punishments and to please others (Ng, 2005). This finding was not astonishing given that the Malaysian educational context relies heavily on achievement performance (Smart School: The Story So Far, 2003), and has consequently been labeled, among others an examination-dominated culture (Smart School: The Story So Far, 2003), teacher-centered and memory oriented (Abdul Razak Hussain, Nor Hafeizah Hassan & Shahrin Sahid, 2001).

To account for the control of learning beliefs subscale, descriptive findings indicated that participation in the *i*ELC discussion platform was also successful in encouraging students to belief that they were in control for their individual learning behaviors and outcomes. This was imperative to the learning process because students were more likely to engage in the learning process to achieve the desired learning goals (Ng, 2005). Effective practice of the control of learning beliefs subcscale allowed students to belief that their efforts in their learning process will bring about positive outcomes independent of external factors such as the teacher (Pintrich et al., 1991). On the whole, students who

participated in the *i*ELC discussion platform were more inclined to study strategically and engagingly because they believe that their efforts will make a difference in their learning process.

Finally, descriptive findings indicated that participation in the *i*ELC discussion platform was not very successful in encouraging students to reflect on the intrinsic goal orientation subscale. The intrinsic goal orientation subscale measured a student's desire to engage in the learning process for reasons such as challenge, curiosity and mastery of subject content (Sungur & Tekkaya, 2006; Pintrich et al., 1991). Unfortunately, descriptive findings also indicated that students from both the experimental and control groups tended to reflect on similar levels of the intrinsic goal orientation subscale. This finding was astonishing because the intrinsic goal orientation subscale plays a crucial role in encouraging students to engage in the learning process. This clearly supports the fact that achievement performance seems to take the center stage in the Malaysian educational context.

The subsequent discussion draws attention to the second view in practicing the motivation subscales. That is, increase in mean value from the pretest to posttest suggested the type of motivation subscales that were improved during participation in the *i*ELC discussion platform. Only the self-efficacy for learning performance subscale noted an improvement in mean value. This finding implied that students who participated in the *i*ELC discussion platform had improvement in practicing the self-efficacy for learning performance subscale. Furthermore, students who had participated in the *i*ELC discussion

platform seemed to have reflected higher practice of the self-efficacy for learning performance subscale as compared to students who did not participate in the *i*ELC discussion platform. That is, participation in the *i*ELC discussion platform was rather successful in encouraging students to consider one's ability and assurance in accomplishing a given instructional task.

Self-efficacy is an important determinant factor to self-regulated learning (Pintrich & DeGroot, 1990; Bandura, 1986; Schunk, 1985). The concept of self-efficacy refers to self-appraisal of one's capacity and self-confidence in the ability to accomplish as assigned learning task, and their expectations for success (Ng, 2005; Pintrich, 1991). With observation of forum discussion threads and brief discussion with respective teachers, it came to attention that participation in the *i*ELC discussion platform promoted the practice for the self-efficacy for learning performance subscale.

A typical learning scenario that promoted active practice of the self-efficacy for learning performance subscale was generalized as follows. Participation in classroom discussion enabled students to exploit his or her ability in finishing an instructional task. Moreover, the use of the Student Instructional Activity Module also guided and encouraged students to investigate into the instructional task step by step. This was further strengthened with homework assigned by the teacher. The available learning tools and activities in the *i*ELC discussion platform also encouraged active practice of the self-efficacy for learning performance subscale. For instance, participating in forum discussion with adequate knowledge, obtained through classroom discussion and individual learning process,

persuaded students to post answer threads with confidence and makes way for further learning. Ultimately, the continuous cycle of this learning process allowed students to assess their self-confidence and learning competency while engaging in the Physics learning process.

On the other hand, the remaining three motivation subscales fail to show any improvement in practice from the pretest to the posttest. The intrinsic goal orientation noted the lowest decrease in mean value among the other motivation subscales. This was followed with the extrinsic goal orientation and control of learning beliefs subscales. Evidently, these findings implied that students failed to improve practice of these motivation subscales within the period between the pretest and the posttest.

As for the decline in practice for the intrinsic goal orientation subscale, findings indicated that participation in the *i*ELC discussion platform was not successful in encouraging students to engage in the learning process on interests of developing one's knowledge and desire. Upon interviewing the respective students and teachers on the practice of this motivation subscales, it surfaced to attention that students were more inclined towards obtaining good grades for the Physics subject. This was not astonishing given that school examinations emphasize strongly on academic performance. Moreover, brief discussion with students also revealed that sitting for the Physics subject was compulsory if one intends to remain in the science stream. Thus, engaging in the learning process leads back to practicing aspects of the extrinsic goal orientation subscale which, in the context of this study, was to perform academically well. This finding again was apt to the fact that

the Malaysia education system is situated in an examination-dominated culture (Smart School: The Story So Far, 2003).

As for the extrinsic goal orientation subscale, findings indicated that practice of this subscale has seemed to lessen during participation in the *i*ELC discussion platform. That is, students appeared to have less preference for external reasons, such as grades, rewards, performance, evaluation, and so on, for engaging in the learning process. In context of participation in the *i*ELC discussion platform, the findings of the study showed both the advantages and disadvantages to the outcomes of the learning process. The advantages to the outcome implied that students were no longer so dependent on extrinsic acknowledgements such as praises from teachers and peers. This would encourage students to engage in the learning process based on the need for intrinsic acknowledgements such as the desire to master the subject content. On the other hand, the highest possible disadvantage would be that students would be ignorant of obtaining good grades for the Physics subject. This could unfortunately lead to fluctuation in the learning process given that Physics was a rather demanding subject. Thus, the researcher considers that practice of extrinsic goal orientation in the *i*ELC discussion platform do possess the ability to encourage students to actively engage in the learning process, although it was more fundamental to the learning process that students to drive on intrinsic goal orientation.

As for the decline in practicing the control of learning beliefs subscale, findings pointed out that participation in the *i*ELC discussion platform was also not very successful in

encouraging students to exercise better control for their own individual learning behaviors and outcomes. Practice of the control of learning beliefs subscale oblige students to be more consciously engaged in the learning process and this was enormously necessary in order for students to be accountable for their respective learning processes (Pintrich et al., 1991). Discussions were held with respective school teachers in attempt to identify possible reasons that led to low practice of the control of learning beliefs subcscale. First and foremost, to engage in the learning process of the Physics subject was a new exposure to students in Form Four. It was also important to point out that only a fraction of the Physics subject was integrated in the Science subject in Form Three, and even so the Physics subject content was more demanding than that of the Science subject which was offered in lower secondary. In addition, the structure of learning activities of the Physics subject was also different than that of the lower secondary Science subject. For instance, students were exposed to new symbols, formulas, concepts and essays that were not so prevalent in the lower secondary Science subject.

Respondents in both groups demonstrated moderate practice of learning strategies. However, respondents in the experimental group showed improved practice of learning strategies compared to respondents in the control group. This finding implied that students who participated in the *i*ELC discussion platform improved their practice of learning strategies as compared to students who did not participate in the *i*ELC discussion platform.

Qualitative data were again acquired through means of semi-structured interview to investigate and support these quantitative findings on practice of learning strategies. When students were enquired generally on their practice of learning strategies the students again indicated that the Form Four Physics KBSM subject was different from the Form Three integrated Science subject, suggesting that they definitely require more time to familiarize with the new subject. However, the students indicated that participation in the *i*ELC discussion platform did allow them to more effectively practice the identified learning strategies as compared to traditional classroom teaching and learning process. When these students were enquired further on how participation in the *i*ELC discussion platform was able to harness their practice of learning strategies, several students pointed out that participating in forum discussions encouraged them to rehearse and elaborate on important abstract concepts. There was also consensus among students that participation in the *i*ELC discussion platform gave them more encouragement to seek assistance from other users and led them to engage in peer learning. Teachers, while agreeing with these comments from students, asserted that the continuous learning process from the classroom to participation in the *i*ELC discussion platform and back again to classroom learning enabled the students to improve their practice of the identified learning strategies.

6.2.2 Findings of the Learning Strategies Scale

The following discussion would highlight the descriptive analyses of the Learning Strategies Scale in their respective subscales to allow for a better understanding on the

practice of learning strategies. Results of descriptive analysis clearly suggested a twofold view in practicing the learning strategies subscales. First, high posttests mean scores indicated the practice of the learning strategies subscales were applied in the learning process. Second, increase in mean scores from the pretest to posttest suggested the learning strategies subscales that were improved during participation in the *i*ELC discussion platform.

Based on descriptive statistics, the elaboration strategy recorded the highest posttest mean value. This was followed with the help seeking subscale and the time and study environment subscale. On the other hand, the critical thinking subscale registered the lowest mean value. This finding implied that participation in the *i*ELC discussion platform was effective in encouraging students to practice the elaboration subscale. Practice of this subscale was particularly necessary given that learning process of any science subject; in this case the Physics subject required much elaboration skill. For instance, to possess the ability to elaborate on definitions, formulae, and concepts for Physics essay writing. Effective practice of the elaboration strategy assist students in the retention of knowledge in long-term memory by making connections between the information acquired (Ng, 2005).

As for the help seeking subscale, participation in the *i*ELC discussion platform was successful in influencing students to seek help from other students and course facilitators in the *i*ELC community. This was imperative to the learning process because when attempting to seek help, student should be honest in identifying aspects of the Physics

subject content that they were not knowledgeable with and this takes courage. Pintrich et al. (1991) asserts that a number of research suggests that peer help, peer tutoring and individual teacher assistance were able to facilitate student's learning process. In the *i*ELC discussion platform, students engaged in help seeking strategy by posting questions in forum discussion and using the dialogue learning tools for a private conversation between other students of the community. In addition, students were also encouraged to participate in classroom discussion prior to and subsequent to participation in the *i*ELC discussion platform.

Participation in the *i*ELC discussion platform also saw the organization strategy as the third most practiced learning strategy. However, it must also be stressed that the *i*ELC discussion platform was not designed to particularly cultivate the practice of the organization strategy. Thus, seeing the organization subscale as the third most practiced strategy was evidence of incidental learning process that most likely occurred from participation in the *i*ELC discussion platform. Pintrich et al. (1991) points out that the organization strategy assist students to select appropriate information and to build connections between information to be learned. Effective practice of the organization strategy also results for a deeper understanding of the subject matter (Weinstein & Mayer, 1986). Exercising the organization strategy allowed students to assess necessary information from the list of discussion threads as well as classroom discussion. For instance, students were guided to identify the main idea from a discussion thread and to outline the necessary information from the discussion thread.

As for the critical thinking subscale, findings suggested that participation in the *i*ELC discussion platform was not very successful in encouraging students to critically assess the teaching and learning process. Pintrich et al. (1991) points out that effective practice of the critical thinking strategy allow students to apply previously learned knowledge to new situations. However, the practice of the critical thinking strategy in the experimental groups was slightly higher than that of the control groups. Students from the experimental group were enquired generally of how they practiced critical thinking in their learning process.

Findings from the semi-structured interview implied that practice of critical thinking could be attributed to the use of the Student Instructional Activity Module. The Student Instructional Activity Module, which provided students with structured learning case scenarios, worked as a guide for them to engage in the *i*ELC forum discussions. These step-by-step problem-solving activities exploited students' abilities to critically assess the use of the Physics definitions, symbols, formulas and concepts. This finding was supported by McKeachie et al. (1986) arguments which emphasizes on problem-solving procedures and methods to allow students to enhance their mastery of critical thinking strategy. When the teachers were asked on their students' practice of the critical thinking subscale, the teachers stressed that it was quite difficult to cultivate critical thinking skills given that the students were just getting familiarized with the Physics subject. However, the teachers did agree that getting the students to practice critical thinking through participation in the *i*ELC discussion platform appeared to be easier than in a traditional setting. One of the reasons, as acquired from the students and teachers, was that learning

conducted in the *i*ELC discussion platform allowed for continuous processing and assessing of information, which persuaded the students to actively assimilate and accommodate their prior knowledge to construct new knowledge and concepts.

The subsequent discussion draws attention to the second view in practicing the learning strategies subscales. That is, increase in mean value from the pretest to posttest suggested the type of learning strategies subscales that were improved during participation in the *i*ELC discussion platform. Based on the descriptive findings, the organization subscale registered the highest improvement in mean value. This was followed by the rehearsal and elaboration subscales. The effort regulation strategy recorded the lowest increase in mean value.

The organization strategy emerged as the highest improved learning strategy among student during participation in the *i*ELC discussion platform. Effective practice of the organization strategy require students to select appropriate information and to create links of learning between this newly found information and the information to be learned (Pintrich et al., 1991). For instance, it was a necessary aspect of participation in the *i*ELC discussion platform that students were able to first identify key information in the forum discussion threads. Subsequently, student must be able to assimilate this information to form a new learning concept. Finally, student must be able to accommodate this assimilated information to novel instructional scenarios that relates to that particular learning concept. This entire process of learning was then repeated in classroom. This

provided a chance to the student to validate his/ her understanding of the concepts formed during online discussion.

The rehearsal strategy emerged as the second highest improved learning strategy among student. This finding implied that participation in the *i*ELC discussion platform was very advantageous in assisting students to practice some aspects of the rehearsal strategy. The rehearsal strategy refers to the recall of information and recitation of information with the primary purpose of defending the selection of important information and the activation of information in the working memory (Pintrich, 1999; Pintrich et al., 1991). Pintrich et al. (1991) addresses these basic skills as the activation of information in working memory rather than acquisition of new information in long-term memory, which was crucial in assisting students to focus and select information associated to the learning process. Effective practice of the rehearsal strategy was imperative in learning the Physics subject because it allows students to master the fundamental use of definitions, symbols, formulas and concepts.

However, Pintrich et al. (1991) emphasizes that practicing the rehearsal strategy does not construct internal connections among newly acquired information, or integration of this information with previously acquired information. In other words, practice of the rehearsal strategy does not reflect on deep level of information processing (Pintrich, 1999), which is eventually useful for learning discrete information (Lynch, 2006). In the context of this study, participating in *i*ELC discussion platform encouraged students to practice the rehearsal strategy through stating definitions, symbols, formulae and

concepts, and recall of information. The rehearsal strategy was also practiced through recitation of items from textbooks, the saying of words aloud, focusing attention to and comprehension of concepts in textbooks.

The elaboration strategy emerged as the third highest improved learning strategy among student. This finding implied that participation in the *i*ELC discussion platform was also useful in assisting students to facilitate the elaboration strategy in the learning process. The elaboration strategy primarily supports the retention of knowledge (Ng, 2005) with the accumulation of information through construction of internal connections between information to be learned (Pintrich et al., 1991). Teachers were asked on the means of practicing the elaboration strategy, to identify factors that led to the development of the elaboration strategy during participation in the *i*ELC discussion platform. The teachers indicated that practice of the elaboration strategy was a necessity in the learning of the Physics subject. That is, it was an imperative aspect of the learning processes for student user to be able to elaborate on definitions, formulas, concepts and calculations. This was again could be conveniently achieved through the continuous participation in the *i*ELC discussion platform and classroom discussions. Moreover, the Student Instructional Activity Module also provided step-by-step guide for students to elaborate on definitions, symbols, formulas and concepts.

As for the Effort Regulation subscale, findings suggested that participation in the *i*ELC discussion platform was also successful in assisting students to be actively involved in the learning process, although this improvement in practicing the subscale was small.

Pintrich et al. (1991) points out that the effort regulation subscale refers to self-regulation of students' effort and attention when faced with distractions and uninteresting tasks. Findings from the semi-structured interview with students suggested that many students claimed the Physics subject to be boring at times and confusing most of the time. With reference to the particular chapter 2 of the Form Four Physics KBSM syllabus in which the students were engaged in, distractions in learning Physics referred to were, for instance, unfamiliar Physics terms (e.g.; *force, inertia*), symbols (a = *acceleration*, m = *mass*), formulae ($a = at + u$, $F = ma$) and concepts (*mass* ≠ *weight, velocity* ≠ *speed*).

On the other hand, the students claimed that most tasks were not interesting such as memorizing the aforementioned Physics terms, symbols, formulae and concepts. Thus, effective mastery of effort regulation strategy was particularly important in the Physics subject since the subject involves understanding of abstract concepts and theories. In the context of this study, practice of the Effort Regulation subscale was encouraged evidently through interaction with other students in the forum discussion. Both students and teachers agreed that discussing definitions, symbols, formulas and concepts with other students through the forum discussions and chat in the *i*ELC discussion platform was a major factor in sustaining the interest to be actively engaged in the learning process. Students expressed their appreciation to be given the opportunity to work through structured learning tasks in collaborative endeavors with other members of the *i*ELC discussion platform. Moreover, the continuous cycle of learning from the classroom environment to the online environment was also beneficial in encouraging practice of the effort regulation subscale. It was also interesting to note that the students did realize the

importance of obtaining good grades for the Physics subject despite the growing level of difficulty of the subject. Hence, the students asserted that they still tried their best to improve their learning of Physics.

6.3 Chapter Conclusion

This chapter puts forward a discussion on the results of the study. These discussions were supported with references and theories as were presented in Chapter 2 “Literature Review”. This chapter was divided into two major discussions. First, discussion was on the participation in the *i*ELC discussion platform as opposed to the traditional teaching and learning approach. Second, discussion was on the self-regulated learning results, which was based on the Motivation Scale and the Learning Strategies Scale.

The following chapter puts forward the summary, conclusions, implications and recommendations for this entire study.

CHAPTER 7

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

This chapter presents the summary, conclusions, implications and recommendations of the study. The summary forwards a synopsis of each chapter, delineating aspects imperative to the study. The conclusion forwards a deduction of key findings of the study. Finally, the chapter offer recommendations based on findings of the study for further improvement and subsequently to warrant further research.

7.1 Summary of the Chapters

With the recent implementation of the Ninth Malaysian Plan, attention was focused for more extensive diffusion of ICT in the teaching and learning process. This focus on the integration of ICT in the teaching and learning process was also aimed to advocate student-centered learning. This awareness surfaced from numerous studies in the Malaysian context indicating students being overwhelmed in an examination-oriented-dominated educational system. Thus, there was a strong need to integrate ICT into the teaching and learning process in an attempt to foster optimal students' participation. However, the costs to develop, implement and administer ICT-based teaching and learning platforms proved to be a huge financial concern, which, more often than not,

impedes the notion of introducing ICT into the teaching and learning process particularly in regular national secondary schools.

Given the recent development and utilization of open source software in the public domain, there has been proliferation of interest in infusing ICT into the teaching and learning process through means of asynchronous and synchronous participation in online learning platform. This study put forward a study in the Malaysian context in which the open source Moodle software was used as a platform to develop the *i*ELC discussion platform. The *i*ELC discussion platform was an online community of students and teachers working mutually to improve the teaching and learning process. This exploitation of open source Moodle software was essential since it possesses strong potential to moderate the financial concerns.

The following discussion underlines the fundamentals of each chapter, leading to an understanding of this entire documentation of the study. Chapter 1 put forward the problem of the study supported by the background of the study, which led to the proposal of the *i*ELC discussion platform. Attention was also highlighted on the need to advance the practice of self-regulated learning in the teaching and learning process as means of bringing about a more active role for students in the classroom. Table 7.1 presents the objectives of the study with the corresponding hypotheses. The chapter also discussed the significance of the study.

Table 7.1: The objectives and hypotheses of the study

Objective	Hypotheses
i) To develop the proposed online discussion platform termed as the *i*ELC discussion platform;	-nil-
ii) To investigate the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning strategies in the learning process;	H1: There was a significant testing main effect between the pretest and non-pretest groups on self-regulated learning posttest mean scores
	H2: There was a significant treatment main effect between the experimental and control groups on self-regulated learning posttest mean scores
	H3: There was a significant interaction effect between the testing effect and treatment effect on self-regulated learning posttest mean scores

Chapter 2 forwarded a review of literature relevant to the study. The constructivism theory of learning was applied as the basis for advancing effective practice of self-regulated learning in the teaching and learning process. Moreover, the constructivist approach was opted as the theoretical scaffolding for participation in the *i*ELC discussion platform because it allowed for optimal student participation in the teaching and learning

process, while subtly shifting the role of teachers from the dominant provider of knowledge to facilitating the learning process. During participation in the *i*ELC discussion platform, responsibilities of the teachers included mediating knowledge in a stimulating learning environment in which the students could actively participate. Engaging in a constructivist learning environment encouraged the students to experience peer learning and peer tutoring for meaningful acquisition and construction of knowledge.

Review of literature was also looked at the importance of practicing self-regulated learning in the teaching and learning process. Findings of numerous studies have pointed out that effective practice of self-regulated learning harnessed students' motivation, skills and strategies to actively engage in the teaching and learning process. Thus, self-regulated learning was viewed as a predictor of success in academic learning. The review of literature also brings to attention the use of open source Moodle software as a platform to develop online learning communities. This study investigated the possibility of having the *i*ELC discussion platform as an alternative but effective means of infusing the Internet into the teaching and learning process.

Chapter 3 focused on the project management of the *i*ELC discussion platform. This chapter was important because it provided a guideline to the design and development aspects of the *i*ELC discussion platform. The ADDIE instructional design model was used as the guideline to design and develop the *i*ELC discussion platform. The ADDIE model comprised of five phases, which were analysis, design, development,

implementation and evaluation. This chapter provided a brief introduction of the ADDIE model which then led to an in-depth understanding on the integration of the ADDIE model with the *i*ELC discussion platform in advancing effective practice of self-regulated learning in the teaching and learning process.

Chapter 4 outlined the methodology of the study. The Pretest-Posttest and Posttest Only Nonequivalent Group Design was employed for this quasi-experimental study. In this research design, four schools were randomly selected from the federal territory of Kuala Lumpur through a two-stage cluster sampling technique. The study only focused on urban schools. Out of these four schools, two schools were randomly assigned to the experimental group while the remaining two schools assigned to the control group. The samples of the study were students sitting for the Form Four Physics KBSM subject. The subjects (n = 102) comprised of 50 students (male = 23, female = 27) from the two schools in the experimental group and 52 students (male = 30, female = 22) from the two schools in the control group. Only the Chapter 2: Kinematics and Motion of the Form Four Physics KBSM syllabus was covered during the students' participation in the *i*ELC discussion platform. The Motivated Strategies for Learning Questionnaire (MSLQ) were the self-rating instruments used to measure students' practice of self-regulated learning before and after administration of the treatment. Only students in the experimental group were subjected to the treatment which was participation in the *i*ELC discussion platform. Students in the control group were not subjected to the treatment and experienced the traditional teaching and learning method. The traditional teaching and learning method refers to the usual 'chalk and talk' approach.

Prior to the implementation of the actual study, the instruments were pilot tested to detect any possibilities of confusing items. The pilot tests for these instruments allowed the researcher to measure the reliability and validity of the items as perceived by students in the Malaysia context. Subsequently, the *i*ELC discussion platform was pilot tested to ensure any possibilities of pedagogical and technical factors that could have disrupted students' participation in the teaching and learning process, which could have also led to contamination of findings. The two-way between-subjects analysis of variance (ANOVA) was used as the statistical analysis to test the hypotheses of the study. This statistical analysis was used because it was able to accommodate the Pretest-Posttest and Posttest Only Nonequivalent Group Design. Moreover, the two-way between-subjects ANOVA was selected based on literature review and opinion of experts of the field.

Chapter 5 presented the descriptive and inferential analysis results of the two-way between-subjects ANOVA. The chapter presented results for the self-regulated learning posttest mean scores data. The presentation of chapter discussion started with results of descriptive analysis and was followed with the inferential analysis. The descriptive analysis presented results of each subscale based on the MSLQ instrument. The descriptive analyses used were mean and standard deviation values. This was to allow a comprehensive picture on the practice of self-regulated learning strategies through participation in the *i*ELC discussion platform. The inferential analysis presented result of significance on the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning in the learning process. The inferential analysis results were

presented according to the hypotheses to be tested, which were formulated based on literature review and the Pretest-Posttest and Posttest Only Nonequivalent Group Design.

Chapter 6 presented the discussion of the study. The chapter started with discussion on the effectiveness of the *i*ELC discussion platform in advancing practice of self-regulated learning in the teaching and learning process. Discussion on inferential analysis was supported with findings of similar studies. On the other hand, discussion of descriptive analysis was focused on the practice of each subscales of self-regulated learning as indicated by the MSLQ instrument. This provide an overview of the most and least practiced self-regulated learning strategy, and the most improved practice of self-regulated learning strategy after participating in the *i*ELC discussion platform. Discussion on descriptive analysis was supported with findings of similar studies, and with findings of semi-structured interview between the researcher with students and teachers subjected to participation in the *i*ELC discussion platform. Descriptive analyses of each dependent variable were discussed according to schools in the experimental and control groups, in the order of SMK Miharja, SMK Vivekananda, SMK Aminuddin Baki and SMK Bukit Bandaraya.

7.2 Conclusions of the Findings

7.2.1 Inferential Analysis on Practice of Self-Regulated Learning

Findings of the two-way between-subjects ANOVA on the self-regulated learning posttest mean scores indicated that there was a significant main effect between the experimental and control groups [$F(1, 98) = 17.92$, $p = .00$] with a large effect size (eta squared = .16) (Pallant, 2001). This implied that the experimental and control groups differed significantly in terms of their self-regulated learning posttest mean scores. That is, participation in the *i*ELC discussion platform was significantly effective in advancing practice of self-regulated learning in the teaching and learning process. Hence, findings of this study strongly suggest students to participate in the *i*ELC discussion platform to improve their practice of self-regulated learning strategies.

7.2.2 Descriptive Analysis on Practice of Self-Regulated Learning

Findings of descriptive analysis indicated the students who were subjected to the *i*ELC discussion platform possessed better practice of self-regulated learning ($M = 5.34$, $SD = 0.92$) compared to students who experienced the traditional teaching and learning method ($M = 4.37$, $SD = 0.83$). The descriptive analysis also indicated a two-fold view on the practice of self-regulated learning. First, high mean values among the posttest results indicated the type of self-regulated learning strategy that students practiced during participation in *i*ELC discussion platform. These are elaboration, help seeking and time and study environment strategies. Second, increase in mean values from the pretest to the

posttest pointed out the type of self-regulated learning strategy that were better developed during participation in the *i*ELC discussion platform. The top three strategies that student developed better were self-efficacy for learning and performance, organization, rehearsal and elaboration strategies. Hence, this study strongly suggests for students to participate in the *i*ELC discussion platform to improve their practice of rehearsal, elaboration, self-efficacy for learning and performance, organization, time and study environment and help seeking strategies.

7.3 Implications and Recommendations for Future Research

Several implications surfaced from this study pertaining to the practice of self-regulated learning through participation in the *i*ELC discussion platform. Thus, several recommendations are listed below which are relevant to teacher educators and to the relevant authorities in the Ministry of Education (MOE).

1. This study focused attention to the practice of self-regulated learning in the teaching and learning process, which has strong implications to the learner and the learning process (Curtis & Lawson, 2001; Garcia & Pintrich, 1994; Schunk & Zimmerman, 1994). This study also explained for improved practice of these strategies in the *i*ELC discussion platform. This necessitates further research of larger sample size and a longer treatment time duration.

2. This study discovered that participation in the *i*ELC discussion platform advanced effective practice of Elaboration, Help Seeking, Time and Study Environment and Effort Regulation. These findings were acquired through use of self-rating instruments and semi-structured interview with students and teachers. Further research should be conducted with findings obtained from students and teachers through structured interview sessions, which could provide an in-depth explanation on the preference on practice of these strategies. Again, this is imperative because it may surface an explanation of infusing the practice of these strategies in the traditional teaching and learning environment.

3. On the other hand, this study also discovered that participation in the *i*ELC discussion platform did not promote effective practice of Intrinsic Goal Orientation, Peer Learning and Critical Thinking. These finding raises concern as the strategies mentioned also has a strong influence on the learner and the learning process. Further research using structured interview sessions with students and teachers may shed light on the reasons for practice on these strategies. Moreover, further researcher may also justify the practice of these learning strategies in the traditional teaching and learning environment, which may guide students in the lower percentiles to achieve better academic performance.

4. This study also provided a robust guideline on the design and development phases of the *i*ELC discussion platform. The researcher proposes further development of

the *i*ELC discussion platform to include practice of self-regulated learning in other subjects such as Chemistry, Biology and History.

5. This study also raised awareness in exploiting the use of the open source Moodle software as a platform for developing online learning communities. Clearly, exploitation of open source software is a necessity and schools cannot be deprived of the opportunity of integrating the Internet into their teaching and learning process due to the high price of commercial software. Moreover, the Moodle software can be easily customized to accommodate any particular subject content and is backed up with a strong community support.

6. In a larger perspective, this study shared that participation in online learning communities is an promising way of encouraging students' optimal participation in the teaching and learning process. Furthermore, there were indications in the study that students liked the idea of engaging in an online learning community. Hence, the researcher proposes an idea to involve more schools in an online learning community. The schools should also allocate several sessions a week for students to communicate with other students through synchronous and asynchronous mode of learning.

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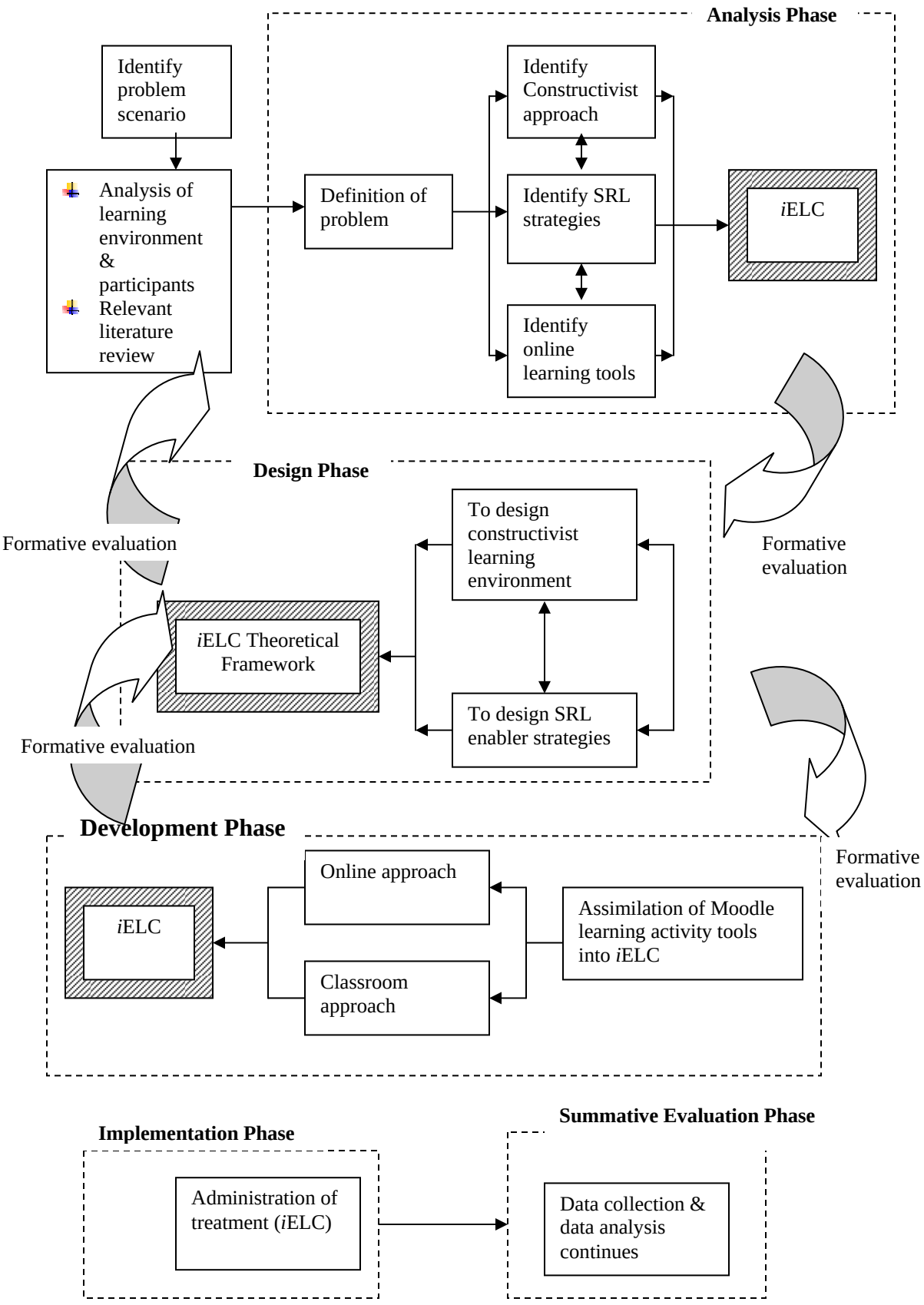
Analysis Phase
Identify problem scenario
Analysis of learning environment & participants
Relevant literature review
Definition of problem
Identify Constructivist approach
Identify SRL strategies
Identify online learning tools
iELC
Formative evaluation
Formative evaluation
Design Phase
To design constructivist learning environment
iELC Theoretical Framework
To design SRL enabler strategies
Formative evaluation
Development Phase
Online approach
iELC
Classroom approach
Assimilation of Moodle learning activity tools into iELC
Formative evaluation
Implementation Phase
Administration of treatment (iELC)
Summative Evaluation Phase
Data collection & data analysis continues

Lists of Experts Identified for Instrument Validation

Experts	Position	Expertise
Dr. Samsilah Roslan	Senior Lecturer, Faculty of Educational Studies, Universiti Putra Malaysia	- Self-regulated learning - Back-to-back translation
Dr. Noreen Noordin	Senior Lecturer, Faculty of Educational Studies, Universiti Putra Malaysia	- Back-to-back translation
Dr. Thang Siew Ming	Associate Professor, School of Language Studies and Linguistics, Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia	- Development of the instrument
Dr. Hanafi Atan	Professor, School of Distance Education, Universiti Sains Malaysia	- Self-Regulated Learning - Integration of Physics education into the development of the instrument
Dr. Rozhan Idrus	Professor, School of Distance Education, Universiti Sains Malaysia	- Self-Regulated Learning - Integration of Physics education into the development of the instrument
Dr. Loh Sau Cheong	Senior Lecturer, Faculty of Education, Universiti Malaya	- Self-Regulated Learning - Development of the instrument in determining the necessity of quantitative items on the instrument

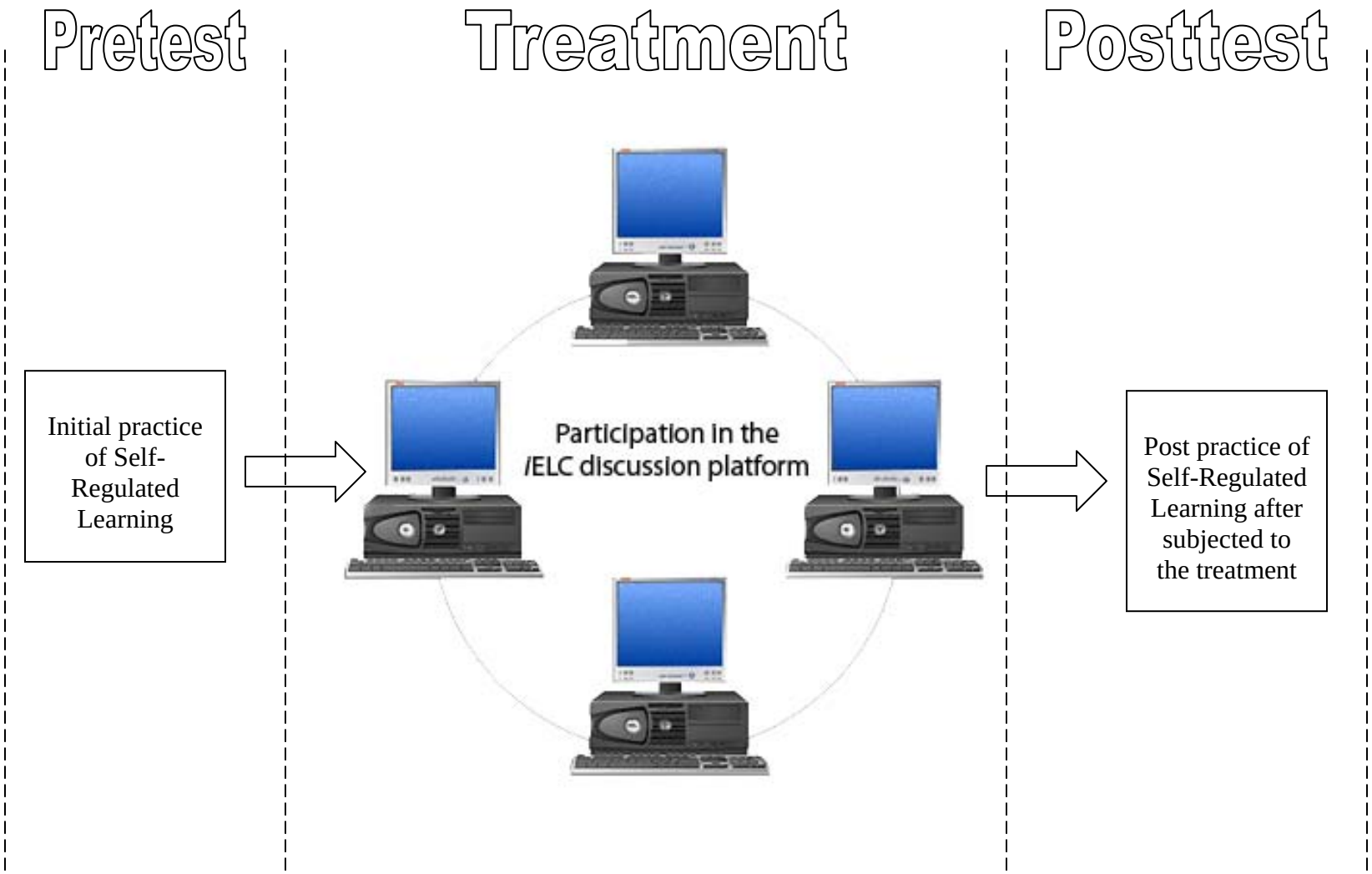

Figure 2.3: Conceptual Framework

Table 5.8: Mean scores of the Motivation scale

	SMK Miharja		SMK Vivekananda		SMK Aminuddin Baki		SMK Bukit Bandaraya	
	Pretest Mean (SD)	**Posttest Mean (SD)**	**Pretest Mean (SD)**	**Posttest Mean (SD)**	**Pretest Mean (SD)**	**Posttest Mean (SD)**	**Pretest Mean (SD)**	**Posttest Mean (SD)**
Intrinsic Goal Orientation	14.90 (3.96)	13.00 (4.15)	16.91 (4.12)	15.57 (3.60)	-	15.17 (3.78)	-	13.79 (3.47)
Extrinsic Goal Orientation	22.81 (6.23)	19.71 (6.56)	23.96 (3.82)	21.83 (4.93)	-	23.79 (5.60)	-	21.34 (4.79)
Control of Learning Beliefs	23.00 (5.88)	19.05 (5.95)	23.87 (4.45)	21.83 (4.60)	-	23.79 (5.19)	-	20.48 (4.90)
Self-Efficacy for Learning and Performance	16.71 (7.38)	17.19 (5.76)	23.04 (4.62)	20.48 (5.32)	-	17.45 (6.90)	-	18.72 (6.25)

Table 5.11: Mean scores of the Learning Strategies scale

	SMK Miharja		SMK Vivekananda		SMK Aminuddin Baki		SMK Bukit Bandaraya	
	Pretest	**Posttest**	**Pretest**	**Posttest**	**Pretest**	**Posttest**	**Pretest**	**Posttest**
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Rehearsal	11.00 (3.66)	17.62 (3.23)	13.17 (5.00)	13.00 (4.35)	-	17.17 (3.68)	-	11.52 (3.92)
Elaboration	27.17 (8.39)	34.14 (7.88)	28.91 (8.90)	31.57 (9.24)	-	33.55 (9.16)	-	27.93 (9.28)
Organization	13.29 (4.48)	19.96 (5.17)	15.65 (4.26)	16.83 (6.12)	-	19.69 (4.87)	-	14.28 (4.74)
Critical Thinking	10.05 (3.79)	14.76 (2.02)	11.61 (3.76)	12.35 (3.83)	-	15.38 (3.81)	-	10.24 (4.23)
Metacognitive Self-Regulation	13.38 (3.89)	16.48 (4.56)	14.91 (3.29)	18.04 (4.55)	-	19.38 (4.48)	-	15.34 (5.35)
Time & Study Environment	18.33 (4.07)	22.71 (3.68)	20.04 (4.80)	19.22 (4.74)	-	23.24 (3.65)	-	17.41 (3.57)
Effort Regulation	17.95 (3.15)	20.29 (3.64)	15.00 (3.38)	15.09 (2.33)	-	23.38 (2.99)	-	16.48 (4.15)
Peer Learning	10.38 (3.40)	14.95 (3.07)	13.17 (3.65)	11.52 (2.87)	-	15.79 (3.34)	-	10.69 (3.58)
Help Seeking	18.19 (6.06)	23.81 (6.14)	22.00 (4.11)	21.43 (5.26)	-	24.48 (6.46)	-	19.34 (6.65)

LIST OF PUBLICATIONS

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- **Vighnarajah**, Wong Su Luan & Kamariah Abu Bakar (accepted). Considerations of Design and Development Aspects of Collaborative Technologies to Facilitate Ideas on Open Learning. The Fifth Pan-Commonwealth Forum on Open Learning, University of London, United Kingdom, 13-17 July 2008 organised by the Commonwealth of Learning. (Accepted)

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