PERCEPTIONS OF COMPUTER-SUPPORTED COLLABPRATIVE LEARNING (CSCL) AND ITS EFFECT ON LEARNING PERFORMANCE, SELF-REGULATED LEARNING AND SUSTAINABILITY BEHAVIORS

by

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Thesis submitted in fulfillment of the requirements

For the degree of

Doctor of Philosophy

December 2009

Acknowledgement

I would like to express my gratitude to Dr. Sharifah Norhaidah Syed Idros, my supervisor for her invaluable guidance, constructive comments, encouragement, and support throughout my studying in USM from the very beginning. I felt fortunate having an opportunity to work in her research group and gain particular research experience from professional researchers. Special thank to Dr. Zurida Binti Ismail, my co-supervisor for being so helpful and instructive for my writing up. Without her dedication and sacrifice both of her time and supervision, I would not have been able to complete this thesis.

I am grateful to the Director of Surattpittaya School, Surat-Thani, Thailand for his permission and support regarding my pursuing for further study. My appreciation also extends to all my colleagues in school for their unselfish friendship, constant encouragement and emotional support during the research period.

My deepest gratitude goes to all of the people in my family. Thank you to my great parents, who were the first teachers in my life and made me as I am today. Thank you to my dear bothers and sisters for their support and encouraging words whenever I need them. My special thanks go to my patient husband and my beloved son who are always my true inspiration that keeps the home fire burning. This thesis would not have been possible without their love and support.

My special appreciation goes to all of my friends and colleagues whom I have met and shared my feelings with, academically as well as emotionally while I was working in the research team. Special thanks to good friends of mine in the co2connect

research group for helping me out whenever I was in need. It would have been impossible to finish this thesis if I had not been in such good companies. All of their support, suggestions and assistance throughout this research have made my life in USM even more rewarding and memorable. The thoughts and feelings we shared during those days have genuinely made up as a part of this thesis.

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Kersan EU-SUPPORT Social Network ke atas pergetahuan pelajar tentang perubahan keim, pembelajaran terarah kendiri, tingkah laku kelestarian dan persepsi tentang perseleitaran pembelajaran

Abstrak

Jaringan sosial pelajar telah dibangunkan di bawah EU-SUPPORT berdasarkan kepada pembelajaran kolaboratif berbantukan komputer (Computer Support Collaborative Learning, CSCL**).** Jaringan EU-SUPPORT adalah merupakan sub jaringan *Norwegian Environmental Education Network* berfokuskan sekolah dengan tujuan untuk meningkatkan kualiti pendidikan untuk pembangunan lestari. Penyelidikan terhadap jaringan CSCL ini melibatkan penilaian terhadap penglibatan dan kualiti perbincangan/interaksi, tahap pembinaan pengetahuan dalam jaringan kolaboratif dan keberkesanan persekitaran pembelajaran terhadap prestasi pembelajaran, tingkah laku pembelajaran terarah kendiri, tingkah laku kelestarian pelajar serta persepsi pelajar tehadap persekitaran CSCL. Peserta jaringan ini terdiri daripada 200 orang pelajar sekolah menengah dari Malaysia dan Thailand. Para pelajar yang terlibat dalam jaringan ini telah berkerjasama dalam melaksanakan aktiviti atas talian dengan tema 'Perubahan Iklim' (*Climate Change*) melalui arahan yang diberikan secara atas talian. Pembangunan jaringan sosial ini telah dipantau dan interaksi sosial antara peserta telah dikaji dengan menggunakan Analisis Jaringan Sosial (*Social Network Analysis, SNA*). Tahap pembinaan pengetahuan ditentukan melalui analisis konten menggunakan model analisis interaksi atau '*Interaction Analysis Model*' (IAM). Soal selidik laporan kendiri dan ujian konsep perubahan iklim telah diberikan sebelum dan selepas aktiviti dilengkapkan untuk mengkaji tingkah laku kelestarian, tingkah laku

pembelajaran terarah kendiri, persepsi dan prestasi pelajar. Keputusan menunjukkan bahawa jaringan pelajar yang telah dibangunkan ini dianggap aktif dengan jaringan yang padat. Forum perbincangan yang dihasilkan dalam jaringan telah terbukti dapat dikekalkan. Kesemua lima fasa pembinaan pengetahuan dapat diperhatikan dalam forum perbincangan namun kebanyakan nota adalah terhad kepada fasa awalan. Analisis statistik soal selidik mendapati bahawa aktiviti pembelajaran kolaboratif dalam jaringan sosial ini mampu meningkatkan secara signifikan tahap pembelajaran terarah kendiri, tingkah laku kelestarian dan prestasi pembelajaran para pelajar dengan tanggapan positif terhadap persekitaran pembelajaran.

The Effect of EU-SUPPORT Social Network on Students' Knowledge on Climate Change, Self-regulated Learning, Sustainability Behaviors and Perception about Learning Environment

Abstract

A student social network was established under EU-SUPPORT based on computer-supported collaborative learning (CSCL). The EU-SUPPORT network is a sub network of the Norwegian Environmental Education Network that focuses on schools to promote the quality of education for sustainable development. The investigation into CSCL network involved examining participation and quality of discussion/interaction, the degree of knowledge building in this collaborative network and the effect of learning environment on learning performance, self-regulated learning behaviors, sustainability behaviors as well as students' perception of the CSCL environment. Participants were 200 secondary school students from Malaysia and Thailand. Students who took part in this project collaboratively worked on assigned online activities with the theme 'Climate Change' via web-based instructions. The development of the social network was monitored and social interaction amongst participants was examined using Social Network Analysis (SNA). The level of knowledge building was determined by Content Analysis (CA) using Interaction Analysis Model (IAM). Self-reported survey questionnaires and test items on the concepts of 'Climate Change' were administered prior and after the activities in order to investigate sustainability behaviors, self-regulated learning behaviors, learners' perception and performance. The results indicated that the established student network was considered active with rather dense network. The discussion forum produced in the

network was proven to be sustained. All five phases of knowledge building were observed in discussion forum however, most posting notes were restricted to the initial phase. The questionnaire statistical analysis revealed that collaborative learning activities in this social network significantly improved self-regulated learning behaviors, sustainability behaviors and learning performance of students with positive perception towards the learning environment.

Chapter 1

Introduction

1.1 Introduction

In the last decade, there have been dramatic changes in teaching practice to improve learning as high quality education in all educational levels is required. A major goal of modern education is to develop students' higher order thinking skills such as ability to synthesize information, solve problems and self-regulate their own learning in order to prepare them for becoming life long learners. These skills are considered crucially important for students to acquire when undergoing the learning process. According to the constructivist learning theories, learning is a process of knowledge construction and is likely to occur when students are assigned a task that is meaningful to them in the real world setting. The importance of active experience with object is a means of developing thinking skill as stressed by Dewey (1963).

Different teaching methods have been introduced and tried out by teachers in order to promote deep learning among their students. At present, one of the most promising approaches often found being implemented regularly is learner-centered approach. This style of learning involves social context and requires interaction among learners to create productive learning environment, which is considered essential in the learning process. Learners actively construct knowledge by communicating with each other while teachers become facilitators so that required skills are achieved through the ongoing interaction among learners (Lave & Wenger, 1991).

The other factor that causes extreme changes in educational system is the evolution of the Information Communication Technologies (ICT). The rapid development of technology, particularly computer and the internet, have resulted in tremendous alteration in teaching and learning approach. This technology effectively enhances teaching as well as learning either in schools or as distance settings. Learning, therefore, possibly takes place in a face to face situation or as an anytime anywhere platform. Apparently, this learning module provides a great opportunity in learning and creates a significant impact on educational setting. It is also undeniable among teachers and educators that technology has become a great influence on pedagogical shift in teaching and learning practices. Consequently, learning is inevitably affected by technologies (Edelson, Gordin & Pea, 1999).

At present, the transformation in teaching and learning of a subject is where the use of ICT provides new forms of communication that leads to a change in teaching pedagogy to accommodate the subject and means of study (McCormick & Scrimshaw, 2001). Teachers in secondary education are trying to cope with such changes by adapting teaching methods to accommodate the subject content along with technology application in order to provide their students with an opportunity to learn. As a result, there has been an extensive amount of technologies utilized in schools to promote effective learning experience for students. Since the traditional teaching approach is unlikely to prepare students with necessary life skills to solve multidisciplinary problems that are now pressing in our society, a different paradigm in education is required. Hence, students need to be exposed to different learning skills including self-

directed learning, active collaboration, communication and consideration of multiple perspectives (Fischer, Rohde & Wulf, 2007).

1.2 Background of the study

The call for Education for Sustainable Development is rising in education while several efforts have also been attempted towards sustainable practices (Down & Nurse, 2007). The unusual catastrophes that occurred around the globe indicate a particular sign of change in the world nature pattern that are presumably caused by unsustainable practice of human's activities. This problem is commonly known as 'Climate Change' which refers to the increasing of the earth's temperature due to the high concentration of greenhouse gases (GHG) such as carbon dioxide in the atmosphere (U.S. Environmental Protection Agency, 2008). These greenhouse gases accumulatively trap energy that is reflected from the earth surface and hence, causing the rise of the earth's temperature. Consequently, the world's weather pattern is affected by such heat. As a result, there are unforeseen effects causing unpredictable deterioration in the biosphere that leads to ecological problems. These effects include natural disasters that have been continuously observed in recent years. The crisis of unsustainable development is global, particularly, in the aspect of environmental issues. Environmental problems resulting from human activities such as over consumption of natural resources and creation of undesirable pollution have been found to be increasing worldwide.

A report by the Asian Development Bank (1997) claimed that no other part of the world is the imperative for sustainable development greater than it is in Asia and the Pacific. The conditions in this area are increasingly deteriorating with huge range of

environmental problems from the degradation of rural land to the pollution and congestion of the mega cities. Some environmental problems are created locally, such as the pollution of water resources, while others are involuntarily imported from abroad, for instance, acid rain in Japan and Korea comes largely from coal burning in the People's Republic of China (Asian Development Bank 1997).

Consequently, the social and economic costs of environmental degradation in the region are very high. The acute impact of the 1997 economic collapse in the region is evidence of the precarious nature of the last decades of development efforts. This environmental decline and lost social and economic opportunities is reflected in the broad patterns of living conditions. It is predicted that by the year 2040, the population of the Asia-Pacific region is expected to have doubled to an astounding 3.3 billion people while requirements for food will have doubled and the need for water and sanitation quadrupled. The consumption of energy and manufactured goods will increase fivefold, while pollution may increase up to tenfold (UNESCO-PROAP, 1996).

According to the United Nation declaration of the Decade of Education for Sustainable Development (DESD) scheme proposed by the UNESCO during the year 2005-2014, education is emphasized as the key factor to transform our society for a sustainable future. The four major thrusts in chapter 3 of Agenda 21 (UNCED, 1992) are as follows:

1) Improving the quality of and access to basic education,
2) Reorienting the existing education to address sustainable development,

3) Developing public understanding and awareness, and

4) Training programs for all sectors

In order to achieve the setting of goals, it is suggested that existing educational programs be reoriented. Increasing the quality of teaching and learning should be fostered to encourage high quality education and a sustainable learning community. According to the four major thrusts, education for high quality is characterized by the following characteristics: interdisciplinary and holistic, value driven, critical thinking and problem solving, multi method, participatory decision making and locally relevant (UNCED, 1992). Hence, in order to accomplish such education setting mentioned above, multidisciplinary approach needs to be implemented.

Currently, several approaches have been implemented in order to promote productive learning environment for students and encourage them to learn effectively. Effective learning can be seen in activities that enable students to think critically and solve complicated problem in the context that is meaningful to them. Thinking skills are considered crucial for developing other related skills that students require in higher level learning and application of knowledge concerning outside classroom context such as environmental issues. Today's problems that are now pressing our world including global matters are related to everybody in the society. This kind of problems requires complicated skills at particular level of competency to handle the situation. Students should be well prepared to deal with the complexity of future problems by practicing their critical thinking and problem solving skills in the context that is meaningful to them such as local environmental issues through the learning process. Effective learning

environment does not only provide an opportunity to develop necessary life skills but also inculcate sensitivity of concerns and responsibility in those learners participating in the setting. In addition, in productive learning process, self-regulation is also fostered to enhance the opportunity of becoming life long learners so that the goals of sustainability in education can be achieved.

Several relevant teaching practices have been proven promising to produce productive learning environment as suggested in this study: the community of inquiry (CoI), collaborative learning (CL), computer-supported collaborative learning (CSCL) and self-regulated learning (SRL). By integrating these approaches in the teaching system, it is anticipated that a community of sustainable learning is created and learners can achieve the ultimate goals through participating in productive learning environment. Nevertheless, teachers are practically responsible in providing such learning environment for students to learn either in traditional classroom or online setting.

Garrison, Anderson and Archer, (2000) proposed the framework of CoI to describe occurrence of learning experience by the concert of three major elements namely; social presence, teaching presence and cognitive presence. The three elements interact with each other and produce rational learning process in a social network to create learning experience. Social presence is essential in inducing sharing of knowledge among participants that leads to improving of cognitive presence of the individual. The learning process, however, is not considered to be completed without instruction from teaching presence. With an interacting of these components, learning experience is achieved. CoI is proven to be applicable not only in traditional classroom

but also in online setting. It is observed that the interaction resulting from social presence, which is important in producing a sense of community, is possibly created in an online environment (Thompson & MacDonald, 2005).

Among the three elements in CoI framework, it is found that social presence attracts most researchers and educators (Richardson & Swan, 2003). It is assumed that social presence creates interaction among participants and the interaction leads to learning performance (Lave & Wenger, 1991). Additionally, in learning process, a strong relationship between social presence and knowledge acquiring of learners has been observed (Hwang & Arbaugh, 2006). Social presence can be increased in an online setting by collaborative activities which tend to improve the socio-emotional climate in learning setting (Richardson & Swan, 2003). Moreover, it is found that strong community due to social presence leads to promotion of deep learning (Chapman, Ramondt & Smiley, 2005).

On the other hand, cognitive presence has been considered to be a characteristic of higher education (Dauer, 1989). It is described as the extent to which learners are able to construct and confirm meaning through sustain reflection and discourse (Garrison Anderson & Archer, 2001). Cognitive presence, therefore, represents a learning process where an individual collaboratively develop ideas to higher level thinking in a community of practice. However, reaching the level of critical thinking phase in cognitive presence is considered problematic (Garrison et al., 2001). Teaching presence plays a crucial role in a learning setting to ensure effective online learning since interaction among participants needs to be directed and focused in a specific

direction so that cognitive and social process are educationally worthwhile learning outcomes (Garrison et al., 2000).

There are two main constructivist theories which are often discussed in education and online learning: cognitive and social constructivism. Constructivism based on Piaget's model of knowledge emphasizes that individual knowledge construction is based on prior experience and results from interaction with the subject of knowledge and environment. Social constructivism, on the other hand, is based on Vigosky's view of learning and emphasizes the social-cultural environment in which the individual co-construct knowledge in interaction with others.

Collaborative approach is based on Vygotsky's theory that knowledge cannot be achieved by individual efficiently but rather be co-constructed socially in a learning community (Vygotsky, 1978). Hence, it is necessary that the climate of collaboration for learners be created if quality education is the main aim. In traditional learning such as in the classroom, effective collaboration with peers has been proven successful and uniquely powerful learning method (Brown & Palincsar, 1989) Students learn effectively in groups, encourage each other to ask questions, explain and justify their opinion, articulate their reasoning, elaborate and reflect upon their knowledge, that lead to motivating and improving learning.

The use of online technology has brought great opportunities to build up educational setting despite distance and time constraints. Online environment where students collaboratively build up understanding about global issues such as climate change, share ideas and negotiate meanings through social interaction can be

conceptualized by Garrison's community of Inquiry (Garrison et al., 2000). This Community of Inquiry provides a rich collaborative and reflective environment for higher order learning which is required for knowledge construction.

The major component in most online collaborative setting is the discussion forum. Participants actively engage in inquiry based activities when they produce learning outcomes. This knowledge constructing process requires critical thinking skills (Garrison et al., 2001). The effectiveness of collaboration, therefore, can be assessed through participants' collaborative knowledge construction in the online discussion.

One of the most interesting aspects in online learning that many researchers pay attention to is computer-supported collaborative learning (CSCL). CSCL is the situation that learners communicate with the group via computer and the internet and it becomes the most popular approach that has been implemented to encourage social network creation in online setting. Learners' performance in a CSCL learning community is influenced by the social network of the learning environment. Evidence also demonstrated that social network is a central element in collaborative learning (Haythornthwaite, 2002). Learning, in this sense, is a social and collective outcomes achieved through seamless conversation, shared practice and networks of social connection (Brown & Duguid, 1991). Hence, knowledge is actively co-constructed through ongoing social exchanges and collaboration among learners embedded in the social network (Cohen & Prusak, 2001).

Computer technology is a knowledge building tool as it encourages open learning and provides enormous knowledge resources. It presents opportunities for shared thinking and joint knowledge by individuals regardless of distance and timing. Computer environment is also viewed as a cognitive tool that promote specific cognitive skills for learning (Lajoie, 2000) and it also plays an important role in supporting the community of learners (Brown & Campione, 1990).

It has long been acknowledged that collaborative learning benefits traditional classroom settings (Lea, Rogers, & Postmes, 2002). Regardless of the contexts in which learning takes place, keys to the learning process are interactions among students themselves, interactions between instructors and students, and collaboration in learning that results from these interactions (Palloff & Pratt, 1999). It is therefore crucially important that relationship and interactions among participants be nurtured and developed if a learning community in an online classroom is to be built.

According to constructivism, learners construct their own meaning through interaction with peers. Collaborative learning is therefore, supported by constructivist approach. Through collaboration with more advanced people, students can achieve what they might not be able to accomplish when learning on their own. Additionally, with the advent of technology, computer-supported collaborative learning becomes an issue of interest.

With the aid of computer networking, new technology can constitute learning environments that facilitate social interaction and collaboration (Gros, 2001). Online learning makes possible to incorporate collaborative activities through computer

mediated communication (CMC) technologies (Lea et al., 2002). Students can share their ideas and communicate with each other through the Internet regardless of boundaries or time constraints. However, without verbal cues in online communication, students are required to interpret discourse through a series of negotiations of meanings. The potential of CSCL in enhancing collaborative learning is gaining more attention in education and it has been proven that CSCL promotes greater cognitive development (Gros, 2001). There are still open possibilities that CSCL is used to create productive online learning environment when combined with other learning approach.

CSCL is a relatively new pedagogical approach to create a powerful learning environment in combination with the ideas of collaborative learning and networked technology (Jarvela, Hakkinen, Arvaja, & Leinonen, 2004). Combined with the affordance of CSCL environment, Scardamalia and Bereiter (1994) proposed a knowledge building approach which focused on learners' collective cognitive responsibility for the advancement of knowledge. The focus on this knowledge building is not only on sharing information but the continual improvement of ideas through interaction with one another (Scardamalia, 2002).

According to Bereiter (2002), knowledge building is a process through which knowledge advances in human societies, and that learning can also take place during a process of knowledge building. This knowledge building framework can become a theoretical rational basis for CSCL approach that participation and interaction are the enablers of learning and knowledge building in CSCL environment (Sing & Khine, 2006). In a shared networked space provided in CSCL settings, students could make

their ideas explicit and share with others to advance the knowledge of the collective to become a knowledge building community.

Obviously, the role of the computer that mediates communication and support learning is seen as an important issue to provide productive learning environment regardless of constraints due to space and time. The setting significantly enhances opportunity to interact and collaborate in learning activities among distributed learners who share the common interest and particular goals.

Apart from essential skills that should be promoted in a learning process, it is also important that students are able to regulate their own learning effectively towards certain goals. It is noted that a person who has developed self-regulated learning is able to self-direct the process by which the mental abilities are transformed into academic skills (Zimmerman, 2002).

Self-regulated behaviors are considered crucial in online learning environment where learners are required to take charge of their own learning in order to achieve learning objectives (Young, 1996). Self regulation is intrinsic motivation, and strategic action (Zimmerman, 1990) that is developed in a person through the learning process in a productive environment. It is also found that self-regulatory behavior appears to be related to academic success (Zimmerman, 2000). In addition, the ability to self-regulate their own learning practically indicates higher levels of intellectual development in learners (Bell, 2007).

Self-regulated learning becomes a crucial issue in educational interest due to the particular reason of the extent to which learners are capable of regulating their own learning which greatly enhance learning outcomes (Whipp & Chiarelli, 2004). Self regulated learners tend to seek challenges and overcome obstacles either with persistence or inventive problem solving (Paris & Byrnes, 1989). Besides, it is claimed that positive expectation, motivation and the use of diverse strategies are prominent characteristics of self-regulated learners in the learning context (Paris & Byrnes, 1989). Additionally, the rising interest in self-regulation and self-regulated learning is associated with the issue concerning lifelong learning perspective which is increasingly important in educational scheme. This is because these learning environments are likely to be highly learner-centered with less instructor-oriented, and hence, they will require self-regulatory skills to a greater extent (Hofer, Yu & Pintrich, 1998).

Along with lifelong learning aspect, there is an educational endeavor to address sustainability through learning system while the ultimate goal is to transform our society into sustainable future (Tilbury & Cooke, 2005). Similar to other learning context, learning for sustainability requires learners to develop sustainability behaviors based on values and attitudes from acquired knowledge about sustainability. However, in order to turn knowledge into practices towards sustainability, learners should be capable of directing their own learning to achieve common objectives as well as being self-motivated to learn with practical strategies. The abilities to approach academic tasks with confidence and purpose, set realistic goal and use a battery of resources that lead to effective learning are considered properties of self-regulated learners (Steffen,

2006). Without self-regulatory skills, it is unlikely that learners are able to transform knowledge into desirable attitudes and later, move forwards from attitudes to sustainable behaviors. A person who has developed self-regulated learning is claimed to be more capable to self-direct the learning process by which the mental abilities are transformed into academic skills (Zimmerman, 2002). These abilities are considered essential in directing learners towards setting goals. Therefore, self-regulated learners are active learners with focused aims in mind and capability in integrating necessary strategies to acquire knowledge.

Self-regulated learning comprises interactions between students' knowledge, meta-cognitive skills motivation, and cognition (Butler & Winne, 1995). However, in socio-cognitive perspective, SRL includes learner's behaviors and motivations as well as aspects of the learning environment that affect learner achievement (Boekaerts & Corno, 2005). Thus, SRL occurs when students are motivated to reflectively and strategically engage in learning activities within environments that foster self-regulation (Patrick, & Middleton, 2002). It has been observed that self-regulating learners persist when facing with challenge, and continually improve and adapt across a range of learning tasks in classroom, and other contexts (Boekaerts, Pintrich & Zeidner, 2000).

In learning context, students should be encouraged to take control of their own learning in order to foster self-regulation and inculcate self-regulatory behaviors. However, to promote self-regulated learning, it is critical that students are motivated to learn and engaged in learning activities in productive environment which they are allowed them to develop self-regulation and reflect their implemented self-regulated

learning strategies effectively. Hence, the teacher's role is to provide information and opportunities to students that will help them become strategic, motivated, and independent learners (Paris & Paris, 2001).

1.3 Education for sustainable development

According to the United Nation declaration of the Decade of Education for Sustainable Development (DESD) 2005-2014, the role of education is increasingly emphasized. The major thrusts of the agenda (Agenda 21, UNCED, 1992) indicate the need in orientating the existing education to address and promote public understanding and awareness about sustainable development. With a fast pace in several dimensions of unpredictable global issues, environmental issues are considered urgent matters that need to be signified in school curriculum where a sense of concern and responsibility should be emphasized.

Education for sustainable development is seen as cross-sectoral and also engages a wide range of institutions. The effectiveness of the strategic practices will crucially depend on the strength and inclusiveness of the partnership, network and alliance among the stakeholders (UNESCO, 2005). UNECE strategic scheme for successful practice of education for sustainable development suggested one of the prerequisites for action of sustainable development is to encourage learners at all levels to use systemic, critical and creative thinking and reflection in both local and global context (UNECE, 2005). Effective ESD should focus on enabling meaningful experience that foster sustainable behavior in education institutes, workplaces, families and communities. Student network, therefore seem to be a key solution to promote collaborative learning

environment in global environment context towards sustainable development. It will also provide a source of information about environmental situation that once in the past was lacking or insufficient due to geographical and cultural barriers. Obviously, if environmental awareness among students is to be effectively addressed, student network initiative should be taken into account.

With the advent of innovative technology and the Internet, it is made possible that networks around the globe are connected for particular purposes. In educational context, network learning is an alternative approach that has been widely implemented for some time and it is proven to be high potential in providing enriched learning environment. Supported by the computer network, computer-supported collaborative learning, communication among participants in the network is facilitated to generate knowledge building through discussion threads. As a result, the efficiency of networks is enhanced regardless of space or time constraints. Geographical limitation that once was signified as a problem of bringing members in the network together for the process of adjusting reciprocal expectation and giving opportunity of knowing and trusting each other (Samoilovich, 1993) can now be overcome by the technology.

The Project Learning for Sustainable Environment was established in 1994 in Asia Pacific region to expand the range of innovative practice used in teacher educator programs though action research network (Fien, Kumar & Ravindranath, 2001). The network illustrates how educational change may be fostered at a regional level by international collaboration among member countries in the network. The aim was to assist teacher educators to include the educational purposes and innovative teaching and

learning strategies of environmental education in teaching programs. The project was carried out through the development of an action research network to support teacher educators to critique and adapt their models in accordance with local cultural and educational needs. The project has created a growing, active network of innovative teacher educator practices and practitioners in environmental education.

Other examples of teacher networks such as Teacher Scientist Network, New Teachers Network and Teacher Support Network (Teacher Scientist Network, 1995; New Teachers Network, 2007; Teachers Support Network, 2007) also share similar goals in establishing the network. The general purposes of teacher networks are to provide particular space for teachers from various perspectives for sharing ideas in teaching as well as exchanging experiences and expertise. Network members also have an opportunity to collaborate and develop teaching materials and teaching strategies on specific interests to improve teaching practices in their classrooms. Apparently, today's teacher networks have become dispensable tools to enhance teaching and learning though the process of collaborative platform.

Niesz (2007) pointed out the crucial role of teacher networks as a bridge between a system that organizes the delivery of education and the support of professional development to the extent that teacher networks is considered flexible for changes to meet the needs of school while allowing teachers to form identity and learn from sharing experiences with other network members. Moreover, participation in the network is voluntary and usually, participants' own goals align with those of the networks. Network therefore, becomes a solution to overcome obstacles that hamper

collaboration and development towards a sustainable future. Apparently, different networks have been established to address the theme of sustainable development worldwide.

At school level, networks established for improving teaching and learning are mostly teacher networks for sharing teaching practices among teachers, teacher educators and practitioners (Niesz, 2007; Keast, Mandell, Brown & Veugelers & Zijlstra, 2002). There are some online connections facilitated by CSCL or web-based instruction for students that focus on learning goals. These connections are either classroom activities with subject-based content such as science (Underwood, Smith, Luckin & Fitzpatrick, 2008) or a specific purpose project among students (Harriman, 2003).

One of the online programs based on subject activities, which is generally known among teachers and students in different countries around the world is Science Across the World (SAW). With the web-based facilitating, the platform of this collaborative network lies on exchanging of collective information among school members. The project themes are mostly concerned with subject content including global issues to engage students in science activities (Science Across the World, 2003). Although the Science Across the World website is widely used by teachers and students around the world, it is suggested that more topics concerning global dimensions should be added while facilitating of peripheral communication is required in order to encourage effective participation.

SAW activities mostly relied on exchanging information related to topics of interests while interactive communication is not available. Generally, students work on the projects, upload the information and compare the results from various locations. Although the context of learning is broadly diverse and useful for class room activities, it is likely that collaborative perspective in terms of online discussion is confined. As a result, instead of promoting advancement of ideas for further step of knowledge building, the phase is restricted to initiation of information sharing (Gunawardena, Lowe & Anderson, 1997).

Student network has not been paid that much attention particularly at secondary school level. Generally, along with subject knowledge, students initially learn and develop values, attitudes as well as life skills through learning activities in schools at their early ages. Besides, in order to inculcate value inherent towards sustainability in these young learners, it is crucial that students are provided an opportunity to interact with peers and engage in well designed learning activities. The potential in learning and developing values towards the setting goal are even greater when they have a chance to share their ideas with other students from diverse background through social network. Learning from experience will broaden their views and change their attitudes so that desirable behaviors for sustainability can be acquired. Student collaborative social network is therefore, seen as a tool to incorporate sustainability in learning platform supported by computer network to enhance the potential of communication and collaboration effort.

The recent network movement in Europe is the Norwegian Environmental Education Network which includes 31 partners in 21 countries as well as affiliated partners from seven non-EU countries including Malaysia and Thailand (Partnership and Participation for Sustainable Tomorrow, 2008). Coordinated by the Norwegian Directorate of Education, the EU-SPPORT (Partnership and Participation for Sustainable Tomorrow) network has been established in order to facilitate cooperation between schools, environmental authorities, research institutes, and NGOs (Norwegian Environmental Education Network, 2008). The network is a resource for promoting training in sustainable development at all levels. It is also expected that this participation and collaboration through network activities will enhance the effectiveness of learning while promoting understanding and global awareness towards sustainability amongst learners.

The Partnership and Participation for Sustainable Tomorrow: EU-SUPPORT network is a Comenius network project under the responsibility of the Norwegian Directorate for Education and Training funded by the European Union Lifelong Learning Program. This prominent network focuses on schools with the goal to promote and enhance the quality of education for sustainable development by linking schools, research institutes and communities in a web-based network. It also aims to increase participation in science studies by making learning more attractive, reduce gender imbalance in science education and promote entrepreneurship by supporting a school culture of innovation and responsibility (Partnership and Participation for Sustainable Tomorrow, 2008).

The main activity in the EU-SUPPORT network is the international campaign of CO_2 on the way to school. The long term purpose of this campaign is to improve the understanding and practice of an education for sustainable development. The activity was designed to engage a large number of schools, students and communities to work in the field of climate and transport on the topic of CO_2 emission. Thailand and Malaysia were also included to participate in the campaign as membership countries. Students from both countries therefore, had an opportunity to learn about the effect of transportation and to share their ideas with other students across the world based on local context. It was expected that with the provided ICT based tools, students will be able to learn and share ideas and increase their competencies in ways described in the learning goals. The homepage of co2nnect website is as shown in figure 1.

Figure 1: Co2nnect homepage of www.co2nnect.org

EU-SUPPORT network is considered a student social network for learning purpose with the incorporation of ESD's aims. The network provides a great opportunity for students from various nodes of the globe and from different learning background to collaborative work on the designed project related to global issues i.e. 'Climate Change'. Newly established with specific purposes and broadly connected with countries across Europe and Asia Pacific, the potential of collaborative network is greatly enhanced. As a result EU-SUPPORT network becomes a potential tool to deliver ideas of education for sustainable development while providing the platform for researching of the established social collaboration amongst learners of different cultures. The social network created during participants actively engaging in learning is worthwhile investigating into so that collaborative learning process occurring in interactions among learners is comprehended.

Collaboration among members in the network is a crucial issue to promote successful network operation. The clear nature of collaborative learning combines perfectly with online learning to create a community of members who are empowered, reflective and who embrace lifelong learning (McCormick, 2004). Hence, the climate of collaboration for participants embedded in the network is essentially important. Apparently, networks become a powerful vehicle to successful ESD by bringing together people of same interests to share a common mission. They also have high potential in creating productive learning environment and providing enriched learning context in accordance with global issues, particularly, when learners participated in the network are distributed geographically.

The network activities will bring about understanding of diverse problems challenging various sites around the globe and also an application of varied values from the different cultures. Value inherent is regarded as an essential element to encourage changes in attitudes and behaviors toward sustainable development and it is strongly recommended to be integrated in learning if the goals of Education for sustainability are to be achieved (Tilbury & Cooke, 2005). Exchanging information and sharing of knowledge among network members through enriched discussion will result in possible solutions for the future while sustainable learning community is expected to be created by interactions of learners in the social network.

The role of students corresponding to global issues as a member of the society is considered critical. The connection of learners from various learning networks will provide a space for sharing and collaboration to discuss the issues that happen around the globe. The forum of discussion will provide initiative information and enrich a sense of shared responsibility for global sustainability issues among learners through out the networks they are embedded.

1.4 Statement of the problem

According to Thailand's educational scheme, the government has launched a series of educational reforms with the aim of developing Thailand into a knowledge-based society. One of these reform focuses on the importance of ICT skills and computer literacy for learning and entering workforce (National Education Act 1999, 2008). In 1997, a large scale of school network was established to link schools all over Thailand for educational purposes under the name Schoolnet Project (Schoolnet

Thailand Project, 2008). Schoolnet network effectively boosts the nation's educational infrastructures by connecting schools and providing accesses to online learning resources for students as well as teachers. However, it is found that the network connection in international level towards sustainability among secondary school students has not been established. In order to broaden vision in learning and international collaboration, it is essential that students have a chance to share their experiences with others from diverse cultures in learning and interacting in order to develop both necessary skills as well as knowledge.

The effort of addressing sustainability through environmental education in Thailand has been observed both in policy making level and practical projects. Public awareness about climate change is risen as an agenda (Buakhamsri, 2007) while sustainable living is suggested as the solution (Thinakul, 2007). Several projects have been carried out such as the government policy to support biofuel production for the increasing consumption (Saka, Koizumi, Arai, et al., 2008) and the promoting of alternative energy production from waste management (Memon & Pei, 2008). However, at school level, there is still a lack of collaboration in a wider range of learning context. In order to create productive learning environment towards sustainability, it is essential that students are encouraged to engage in international collaboration with students from other countries around the globe and regional as in Malaysia.

Similarly, one of the Malaysian educational policies is to prepare human resources for development needs (Ministry of Education Malaysia, 2005). Networks for students in schools with the aim to promote effective learning have been regularly