COLLABORATIVE CONTENT ORGANISER (CCO) LEARNING SYSTEM: STUDY OF TECHNOLOGY ACCEPTANCE AND EFFECTIVENESS

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2015

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by

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Thesis submitted in fulfillment of the requirements for the degree of Doctor of Philosophy

February 2015

ACKNOWLEDGEMENT

First and foremost, I would like to extend my heartiest thanks and appreciation to my supervisor, Professor Dr. Hanafi Atan, for his never-ending support and valuable guidance. Particularly, his willingness to supervise and generous flexibility with my schedule deserves many thanks. His support and attention, has played a great role in ensuring that I continue to thrive to produce a complete research work.

My sincere appreciation also extends to Associate Professor Dr. Shukri Yahaya whom I contacted for his professional statistical advice. A token of appreciation also goes to the other experts and researchers for their useful feedback. I would also like to express my appreciation to survey respondents for the time they took in providing data for this study.

Last but not least, I would like to express my gratitude to my husband, for his ever-present support, love and constant encouragement in helping the research to be a success. An honourable mention goes to my beloved family members for their moral support and tolerance with me in pursuing my Ph.D programme. Without their constant support, critique and encouragement, the road to completing this project would have been desolate, long and hard.

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LIST OF ABBREVIATIONS

CCO	Collaborative Content Organiser
ICT	Information and Communication Technology
IT	Information Technology
IS	Information System
WWW	World Wide Web
LO	Learning Object
LOR	Learning Object Repository
TRA	Theory of Reasoned Action
TPB	Theory of Planned Behaviour
TAM	Technology Acceptance Model
CSE	Computer Self-Efficacy
TR	Training
CA	Cognitive Absorption
IM	Intrinsic Motivation
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
BI	Behavioural Intention
AU	Actual Use
CCOAM	Collaborative Content Organiser Acceptance Model
XML	Extensible Markup Language
IMS	Instructional Management System
MIS	Management Information Systems
MCQ	Multiple Choice Questions
SQ	Structured Questions
AVE	Average Variance Extracted
CG	Control Group
EG	Experimental Group
SPSS	Statistical Package for the Social Sciences

SISTEM PEMBELAJARAN PENYUSUN KONTEN BERKOLABORATIF: KAJIAN PENERIMAAN TEKNOLOGI DAN KEBERKESANAN

ABSTRAK

Kajian ini bertujuan untuk menyelidik persepsi pelajar Pendidikan Jarak Jauh (PJJ) terhadap sistem pembelajaran Penyusun Konten Berkolaboratif (PKB) dan menilai keberkesanannya. Data sampel telah dikumpulkan melalui instrumen kaji selidik dalam talian. Peralatan tinjauan mencungkil jawapan pada beberapa soalan jenis Likert dengan majoriti jawapan yang positif. Kajian ini meninjau hubungan antara pembolehubah yang akan memberi kesan kepada tingkahlaku pelajar dalam menggunakan system pembelajaran PKB. Keberkesanan sistem pembelajaran PKB dinilai berdasarkan peningkatan prestasi pelajar. Hubungan antara penglibatan dalam aktitiviti kolaborasi dan pencapaian pelajar juga diterokai. Keputusan statistik mendedahkan bahawa sistem pembelajaran PKB diterima baik oleh pelajar dan sistem pembelajaran itu dapat meningkatkan prestasi pembelajaran pelajar. Keputusan yang diperolehi juga menunjukkan hubungan yang positif di antara penyertaan dalam aktiviti kolaborasi dan pencapaian akademik pelajar. Kajian ini menyumbang kepada amalan penyelidikan pendidikan dengan menunjukkan persepsi dan prestasi pembelajaran generatif dan kolaboratif di kalangan pelajar PJJ. Pendekatan ini boleh merangsang penyelidikan masa depan dalam reka bentuk dan pembangunan sistem pembelajaran yang lebih kompleks.

COLLABORATIVE CONTENT ORGANISER (CCO) LEARNING SYSTEM: STUDY OF TECHNOLOGY ACCEPTANCE AND EFFECTIVENESS

ABSTRACT

This research aims to investigate the perception of distance education students towards the Collaborative Content Organiser (CCO) learning system and evaluate its effectiveness. The sample data were collected via online survey instruments. The survey instrument elicited responses on a series of Likert-type questions with the majority of responses being positive. It involves examining the relationships between variables that affect students' behavioural intentions to use the CCO learning system. The effectiveness of the CCO learning system was evaluated based on the improvement of students' academic performance. The relationship between the participation of students' in e-collaboration and their achievement was examined too. The statistical results revealed that the CCO learning system is well received by the students and the learning system improves students' learning performance significantly. The results also indicated that there is a positive correlation between participation of students in e-collaboration and their academic achievement. Finally, the study contributes to educational research practice by demonstrating the perception and performance of generative and collaborative learning among distance education students. This approach may stimulate future research in the design and the development of more complex, technology-enriched learning environments.

CHAPTER 1 INTRODUCTION

1.1 Introduction

At present, the use of Information and Communication Technology (ICT) provides a new form of communication that leads to changes and transforms the way teaching and learning is conducted (McCormick & Scrimshaw, 2001). There has been a colossal shift from traditional lecture to student-centred learning. Today, several instructors advocate the student-centred approach in education, which is currently focused on knowledge construction instead of knowledge transmission (Amornsinlaphachai & Deejring, 2012). In student-centred learning, students construct their own meaning by talking, presenting, discussing and sharing their knowledge. Collaborative learning and generative learning strategies have been incorporated into web-based online learning system in order to promote student-centred learning.

Collaborative learning is a situation in which two or more people learn or attempt to learn something together (Dillenbourg, 1999). Collaborative learning breaks the teacher-centred nature of teaching practices and it serves as an essential element for student-centred learning instruction. Generative learning is a process of constructing links between new and old knowledge, or how a new idea fits into an individual's web of known concept (Wittrock, 1991). Generative learning solves a problem of passive transmission on knowledge. The generative learning activity engages students to be active participants in the process of learning and create their own learning by constructing meaning of their own environment.

The prototype system used in this study, namely Collaborative Content Organiser (CCO) learning system provides a pedagogically-enriched learning environment to engage students in collaborative learning through online discussion and interaction and generative learning via concept mapping. The existing learning system is mainly for instructor to upload and student to download the course materials. The students do not perform any generative learning activity to construct new knowledge from prior knowledge and link all the concepts. In computer education, the prior knowledge of students is the foundation of the further knowledge construction (Mirmotahari et al., 2003; White, 2001; Holmboe, 1999; Scragg, 1991). Hence, there is a need to have a learning system that is designed based on pedagogical specifically generative learning for learning the computing courses.

1.2 Research Background

With the rapid development of ICT, instructors and administrators worldwide have integrated and utilised Information Technology (IT) into education to improve students' learning with the appropriate instructional theories that are coupled with technologies. Many courses and programs have been slowly transferred into fully interactive online environments. As pointed out by Saettler (1990), the way of teaching and learning has changed dramatically over the past decade as a result of major developments in educational technology.

In recent years, there has been a phenomenal growth in the use of e-learning for teaching and learning and increased interests in the investigation of the effectiveness and efficiency towards various instructional design strategies incorporating e-learning. E-learning serves as the main support and play a vital role especially in distance learning environment. Distance learning is referred to any form

of learning where individuals are not physically present in a traditional setting that provide individuals with the ability to learn at their own pace and in their own space (Thoms & Eryilmaz, 2014).

There are evidences which indicate that the effectiveness of distance learning programme can be enhanced by using student-centred learning strategies and constructivist learning paradigm (Hannum & McCombs, 2008; Tam, 2000; Wagner & McCombs, 1995). Moeller and Reitzes (2011) also confirm that technology is able to support key practices of student-centred learning. Hence, in this study, constructivism with the principle of student-centred learning was chosen to be incorporated in the learning system to engage learners to be active participants in the learning process. Students construct their own understanding from previous knowledge in either collaborative or self-directed manner instead of predetermined structure.

There are three main types of instructional design theories, namely behaviourism, cognitivism and constructivism. Table 1.1 shows the differences between the three learning theories. For behavioural approach, Gagné (1968) emphasises the importance of creating particular conditions needed for a particular type of learning. For cognitive approach, the emphasis was on design based on characteristics of individual learners while constructivist approach emphasises the learner's own activities as the mechanism for learning (Elen & Clarebout, 2001).

There is a trend to shift from behavioural to cognitive and recently, it is shifting to the constructivist approach. Students no longer passively receive information by just memorising; they instead process the information meaningfully. Learning is not just a cognitive issue but also a matter of participating in cultural

practices (Sfard, 1998) and creating new knowledge and ideas of value to a community (Paavola & Hakkarainen, 2005; Scardamalia & Bereiter, 2003).

Table 1.1 Learning Theories (Keesee, 2011)

	Behaviourism	**Cognitivism**	**Constructivism**
Key Concepts	Focuses on objectively observable behaviours and discounts mental activities.	Focuses on the "brain", how humans process and store information.	Focuses on how learners construct their own meaning.
Learner's Role	Learners are passive, just responding to stimuli.	Learners process, store, and retrieve information for later use.	Learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge and social interactions.
Instructor's Role	Instructor designs the learning environment.	Instructor manages problem solving and structured search activities, especially with group learning strategies.	Instructor focuses on making connections between facts and fostering new understanding in students.

Collaborative learning (Levykh, 2008; Vygotsky, 1978) and generative learning (Bannan-Ritland, Dabbagh & Murphy, 2000) are important elements in constructivist learning environment. Existing researches suggested that incorporating various strategies, such as collaborative learning (Marks, Sibley & Arbaugh, 2005)

and the use of concept mapping techniques (Chmielewski & Dansereau, 1998) for generative learning could positively influence the effectiveness of e-learning.

Collaborative learning is drawing much attention among researchers because of the belief that it is an effective model for the modern education system (Lautenbacher, Campbell, Sorrows & Mahling, 1997). Active interaction, collaboration and participation of learners and instructors are becoming more and more important (Du, Fu, Zhao, Liu & Liu, 2013). Collaborative learning mainly involves working, learning, building and changing together in a learning environment. Educational research has shown that learning takes place more effectively if learners are actively involved, rather than being passive listeners (Nurmela, Palonen, Lehtinen, & Hakkarainen, 2003). According to Lave and Wenger (1998), students actively construct knowledge by communicating and interacting with their peers and achieve the required skills through ongoing interaction among themselves. Van Merrienboer and Paas (2003) observed that working together while accomplishing a task is seen as a characteristic of a powerful learning environment, which facilitates active construction of knowledge. Eichler (2003) found in his study that students in collaborative learning conditions had more constructive learning processes.

Morgan and Berthon (2008) define generative learning as the process of generation, distribution and interpretation of new ideas. Bonn and Grabowski (2001) found in their studies that generative learning provides the necessary theoretical framework for research in a constructivist perspective. In generative learning environment, students are active participants who construct their own learning by generating relationships between the concepts. According to Nickerson (1995),

learning that emphasises on the connection between the new and old concepts, and among the concepts is vital to enhance understanding.

Concept mapping provides an important tool on generative learning environment (Osborne & Wittrock, 1983; Bannan-Ritland et al., 2000). Concept map is a visual representation of knowledge organisation consisting of nodes for concepts and links for their relationships (Novak & Gowin, 1984). According to Tseng, Chang, Lou, Tan and Chiu (2012), Concept mapping allows learners to represent relationships among concepts graphically by applying nodes and links. Jonassen (2000) found in his study that concept map engages learners in the reorganisation of knowledge, explicit description of concept and their interrelationships, deep processing of knowledge that promotes better remembering; and relating new concepts to existing ones that improve understanding. Alpert and Grueneberg (2000) showed that the process of mapping the concepts in multiple forms is easier to understand and learn. Moreover, the research findings from Jonassen, Mayes and McAleese (1993) indicated that individuals learn the most from the design of instructional materials.

Learning object design can be configured within generative learning environments from the theoretical perspective of the generative learning (Bannan-Ritland et al., 2000). Furthermore, the nature and unique attributes of learning object design can be grounded in constructivist principle to provide learner-centred learning. The emergence of World Wide Web (WWW) has provoked the web-based learning. According to Lim (2000), web-based learning environment is able to support learner-centred learning. The flexibility of learning object also allows reusable content through the Web (Mohan & Brooks, 2003). Additionally, WWW

technology tools are able to support learning with the use of hypermedia to link the learning objects.

With the potential benefits of constructivist collaborative learning, generative learning and learning object design, there are questions raised on whether students will accept and eventually adopt the learning system that incorporates generative learning strategy, collaborative learning strategy and learning object instructional design for their learning. It is crucial to understand the factors of information technology system usage in order to evaluate the effectiveness of system and develop solutions for user acceptance (Knight & Pearson, 2005; Davis, Bagozzi & Warshaw, 1989). In this regard, this research aims to examine the relationships of variables that affect students' behavioural intentions to use the CCO learning system.

The prevailing literature on the technology acceptance model (TAM) and its variation have explored the critical determinants of technology adoption and user behaviour (Venkatesh, Morris, Davis & Davis, 2003). TAM is one of the most widely used theoretical models for numerous empirical studies of user acceptance in terms of technology (Turner, Kitchenham, Brereton, Charters, & Budgen, 2010) and have been used by many researchers to explain the behaviours in IT usage (Igbaria, Guimaraes & Davis, 1995).

Although TAM has been applied in numerous studies testing user acceptance of information technology, there is a limited study that uses TAM to analyse the learning system which is incorporated with collaborative learning and generative learning strategies as well as learning object design. With the extended version of Davis's (1989) TAM, this research attempts to determine students' behavioural intention to use the CCO learning system.

1.3 Problem Statements

Gunawardena and McIsaac (2004) criticised the current distance education as a replicate of conventional lecture-based classroom education where students learn individually with little interaction among peers. According to Boling, Hough, Krinsky, Saleem and Stevens (2012), learners do not form online learning communities, but isolate and disconnect from each other most of the time. In addition, several research studies revealed that the lack of personal interaction is the dominant factor to the withdrawal or dropping out of distance education students (Blaney & Mulkeen, 2008; Yorke & Longden; 2008). Hence, collaborative learning activities need to be integrated into the existing learning system to enhance student-instructor interactions or peer-to-peer interactions. In the collaborative learning environment, the instructors facilitate and initiate the discussion of a particular content and moderate the online discussion from time to time during the semester. Students are given the chance to share their knowledge in different ways and participate in a coordinated effort to solve problems together. With this, distance education students will not feel alone throughout their studies.

Numerous studies show that Computer Science students lack understanding of the relationships between the facts they have learned (Mirmotahari, Holmboe & Kaasboll, 2003; Scragg, Baldwin & Koomen, 1994). New information must be linked and correlated to the information already understood (Hamza, Alhalabi & Marcovitz, 2000; Rosenberg, 1976). Rosenberg (1976) also noted that the connection among the concepts is equally important in the landscape of learning in Computer Science. The generative learning performs well with respect to active processing in the linkage of concepts that encourage students to think and construct knowledge from their own understanding. The generative learning strategy also needs to be

integrated into the existing learning system to empower the learning capabilities of Computer Science students.

There have been more and more institutes of higher education, organisations and corporations which integrated learning objects into their e-learning systems in order to make instructional resources more efficient and meet the diverse needs of learners (Urden & Weggen, 2000). Learning objects have become popular instructional resources for teaching and learning (Bannan-Ritland et al., 2000). It is a new type of computer-based instruction grounded in the object-oriented paradigm of Computer Science to decompose course structure into smaller reusable chunks of instructions that can be assembled with other objects or can be used as stand-alone units. Ip and Morrison (2001) have also highlighted that it is crucial to integrate pedagogies into the learning object design for reusable and flexible learning environment.

Additionally, Chao (1999) mentioned that distance education, as a pioneer in the use of technology, not only needs to adjust to the possibilities of advanced technology, but also needs to modify existing structures to enhance lifelong learning. Willis (1995) highlighted that although technology plays an important role in the delivery of distance education, the educators must remain focused on instructional outcomes and not solely relies on the delivery technology. It has also been highlighted that Information Technology (IT) must be accepted and appropriately used by its intended users to achieve the desired goal and for its benefits to be realised (Agarwal & Prasad, 1998; Igbaria, Zinatelli, Cragg & Cavaye, 1997; Goodhue & Thompson, 1995). Moreover, research has found that, the values of an IT innovation lies in its effective and efficient usage but not so much in the technology itself (Kremers & Van Dissel, 2000).

Hoffman (2005) highlighted that the present models employed for evaluation of complex interaction between the three pedagogical dimensions namely technologies, learning resources and management factors influencing e-learning effectiveness have not been entirely tested and developed. Furthermore, Russell (1999) indicated that technology is unable to replace the important role contributed by human factor in higher education. Students' satisfaction, perception and attitude, motivation and demographics will influence how the courses are designed and the type of technology to be used (Rourke & Szabo, 2002).

There is no guarantee for the adoption of an instructionally sound and technically superior instructional resource itself as it is a complex process that is influenced by many factors, such as individual attributes, system characteristics, organisational and social interactions (Surry & Ely, 2002). Hence, it is important for instructors and instructional designers to understand the reason learners use the educational technology to ensure they are using the technology in the expected ways.

The success of any information systems (IS) largely depends on users' satisfaction and acceptance (Bharati, 2003; Seddon, 1997; DeLone & McLean, 1992). Tallman (1994) pointed out that a high level of user acceptance and satisfaction reflects that the users are more willing to continue using the technology. Thus, the understanding of the factors that promote the effective use of systems (Yi & Hwang, 2003) and the measurement of the users' perception (McMahon, Gardner, Gray & Mulhern, 1999) has become an important issue.

User acceptance model was studied tremendously in many fields since the last few decades. Although user acceptance has received extensive attention in many fields, there has been little research in evaluating students' acceptance and their perceived impact on the effectiveness of web-learning system, particularly in the

learning system that incorporates collaborative, generative learning strategies and learning objects design.

With the new delivery methods of e-learning systems, TAM can be used in predicting students' acceptance of IT or IS system. It has been found to be a generous and vigorous model in many e-learning studies (Cheung & Huang, 2005; Drennan, Kennedy & Pisarki, 2005; Liaw & Huang, 2003). Hence, TAM was chosen in this research study to evaluate students' acceptance of the CCO learning system. The four external variables (computer self-efficiency, training, cognitive absorption and intrinsic motivation) were examined to understand how students' belief and perceptions will influence the usage of the learning system.

1.4 Significance of the Research

This research study incorporated methods and theories that may be useful in measuring users' technology adoption or aversion of other information systems and applications. Students' acceptance and perceptions behaviour should be assessed as this reflects if the students will eventually adopt and use the learning system in their learning.

The successful implementation of a system is dependent on the extent to which such a system is used and eventually adopted by potential users. One of the key attributes is to identify the learners' needs, and economically customise the individual learning in order to promote the successful learning (Wiley, 2000). Hence, the students' perception is an important issue to consider before the investment of the learning system as it might become underutilised or even unused.

The research attempts to fill the need of assessing students' perception by constructing a set of questionnaires to measure perceived ease of use and usefulness

of learning system that incorporates collaborative and generative learning activities. The findings of this research study can be used as a guideline for the relevant stakeholders to make necessary improvement to enhance the functionality and features of their learning system. The results gained from this study provide guidelines to further study in implementing other potential instructional technologies in collaborative and generative learning platform.

The findings of this research study will provide better understanding on how well the students perceive the benefits of the collaborative and generative learning strategies in promoting the innovative use of modern educational technology. The result of this study will allow e-learning vendors or administrators to improve students' learning and enhance technology integration by incorporating these learning theories to their existing learning systems.

1.5 Research Objectives

This research aims to:

1) Examine the relationship of variables that affect students' behavioural intention to use the CCO learning system.
2) Evaluate the effectiveness of the CCO learning system (improvement of students' learning performance).
3) Investigate the relationship between the participation of student in e-collaboration and their academic achievement.

1.6 Research Questions

Based on the research objectives discussed earlier, the research is carried out to fulfil the following research questions:

1) What are the relationships between variables that affect students' behavioural intention to use the CCO learning system?
2) Is the CCO learning system effective in enhancing the performance of students?

The research question is broken down into sub research questions as follows:

   (a) Is there any statistically significant difference between the pre-test and post-test mean score of experimental group?
   (b) Is there any statistically significant difference of pre-test mean score between control group and experimental group?
   (c) Is there any statistically significant difference of post-test mean score between control group and experimental group?

3) Is there any relationship between the participation of students in e-collaboration and their academic achievement?

1.7 Research Hypotheses

The following hypotheses are associated with quantitative analyses of the research procedure.

Research Question 1:

H_1: There is positive direct relationship between computer self-efficacy (CSE) and perceived usefulness (PU).

H_2: There is positive direct relationship between computer self-efficacy (CSE) and perceived ease of use (PEOU).

H_3: There is positive direct relationship between training (TR) and perceived usefulness (PU).

H_4: There is positive direct relationship between training (TR) and perceived ease of use (PEOU).

H_5: There is positive direct relationship between cognitive absorption (CA) and perceived usefulness (PU).

H_6: There is positive direct relationship between cognitive absorption (CA) and perceived ease of use (PEOU).

H_7: There is positive direct relationship between intrinsic motivation (IM) and perceived usefulness (PU).

H_8: There is positive direct relationship between intrinsic motivation (IM) and perceived ease of use (PEOU).

H_9: There is positive direct relationship between perceived ease of use (PEOU) and perceived usefulness (PU).

H_{10}: There is positive direct relationship between perceived ease of use (PEOU) and behavioural intention (BI).

H_{11}: There is positive direct relationship between perceived usefulness (PU) and behavioural intention (BI).

H_{12}: There is positive direct relationship between behavioural intention (BI) and actual system usage (AU).

Research Question 2:

H_{13}: There is significant difference between the pre-test and post-test mean score of experimental group.

H_{14}: There is significant difference of pre-test mean score between control group and experimental group.

H_{15}: There is significant difference of post-test mean score between control group and experimental group.

Research Question 3:

H_{16}: There is positive relationship between participation of e-collaboration and mean score increment (post-test minus pre-test).

H_{17}: There is positive relationship between participation of students in e-collaboration with their post-test mean score.

H_{18}: There is positive relationship between participation of the students in e-collaboration with the quality of knowledge constructed measured from the rubric.

1.8 Research Limitations

The followings are limitations which could affect this study:

1. The participants were voluntary. Results from this study cannot be generalised to the population of distance education students.
2. This study confined the scope to selected variables, which were drawn from the previous related literature.

3. Likert-5 scale was used to measure the constructs of the research model. There might be other scale-configurations which fit better to measure the dimensions of the constructs.
4. The results of the study are limited to the population of distance education undergraduates in an institution. Hence, generalisations beyond this population and context need to be taken carefully.
5. The sample of this study is recruited from the population of adult learners. This could mean that different populations might respond differently and the results might be different for young learners.
6. The study is performed on a middle level computer science course. Different course may yield different results.

1.9 Operational Definition

Table 1.2 lists the definitions of important terms used in this research study. There are thirteen terms with their definitions and relevant sources.

Table 1.2 Operational Definition

Term	**Definition**	**Source**
Collaborative Learning	"a situation in which two or more people learn or attempt to learn something together" In this study, students collaborate and interact with instructor and their peers via discussion forum and chat room for knowledge construction and to improve their understanding of a topic.	Dillenbourg (1999)

Generative Learning	"cognitive activities, such as selecting, organising and relating, directed by learners who actually create relationships and meaning between or among information to be learned and learners' existing knowledge" In this study, students are active in generating their own knowledge by constructing lesson maps and creating relationship among the concepts.	Wittrock (1991)
Learning Object	"an object or set of resources that can be used to facilitate the learning" In this study, learning object is referring to learning chunk that is uploaded to the knowledge base that can be used by the students for learning and knowledge construction.	Millis (2002)
Concept Map	"a type of knowledge representation used in education which is a graphical node representation illustrating the relationship between concepts" In this research, concept mapping activities is part of generative learning process.	Novak & Gowin (1984)
Lesson Map	"the hierarchical outline of concept map" In this research, lesson map is a tool used by the students to construct	Tan (2006)

	their own knowledge by generating and linking the relationship between learning objects.	
Effectiveness	"the degree to which something is successful in producing a desired result" In this study, the effectiveness of the learning system is determined by students' post-test mean score. Experimental groups who used the system are expected to have greater improvement from pre-test to post-test than control groups who did not use.	Effectiveness (n.d.)
Computer Self-Efficacy	"individuals' judgment of their ability to use a computer or computer system in the context of IT usage" In this study, this construct measures if students are able to use the CCO learning system without any problems.	Compeau & Higgins (1995); Compeau, Higgins & Huff (1999)
Training	"the acquisition of knowledge and skill to present tasks" In this study, this construct measures if the provided training guide help familiarise students with all the functionalities and features of the CCO learning system.	Fitzgerald (1992)
Cognitive Absorption	"a state of deep involvement or holistic experience with the underlying technology" In this study, this construct	Agarwal & Karahanna (2000)

	measures if students are absorbed in what they are doing while using the CCO learning system.	
Intrinsic Motivation	"the performance of an activity for its inherent interests and enjoyment other than a separable outcome" In this study, this construct measures if students find the CCO learning system enjoyable and motivate them to use the system.	Deci (1972)
Perceived Usefulness	"the degree to which a person believes that using a particular system would enhance his or her job performance" In this study, this construct measures if students find the CCO learning system useful to achieve the learning objectives.	(Davis, 1989)
Perceived Ease of Use	"the degree to which a person believes that using a particular system would be free from effort" In this study, this construct measures if students find the CCO learning system easy to use, navigate with tools and features are user friendly.	(Davis, 1989)
Behavioural Intention	"a measure of the strength of one's intention to perform a specified behaviour" In this study, this construct measures if students have intention to use the CCO learning system again.	(Fishbein & Ajzen, 1975)

1.10 Theoretical Framework

Figure 1.1 shows the theoretical framework of this research study. It is based on constructivist approach where students construct their own knowledge through the interaction with peers and facilitated by their instructor. The pedagogical principle of the CCO learning system was based on generative learning from constructivism learning of Bonn & Grabowski (2001), Grabowski (1996) and Dunlap & Grabinger (1996). The learning objects and generative learning are based from Bannan-Ritland et al. (2000) and Tan (2006). Collaborative approach is based on Vygotsky's theory which emphasises that knowledge cannot be achieved by individual efficiently but rather co-constructed socially in a learning community (Vygotsky, 1978).

In 1978, Vygotsky's theory promotes learning contexts in which students play an active role in learning. Roles of instructor and learner are shifted from traditional way of teaching where an instructor transmits information to students and students passively receive the information. Instead, the instructor collaborates with his or her students and facilitates the construction of knowledge among students.

Constructivism is an educational philosophy that includes two main principles: (1) learning is an active process of constructing knowledge; (2) the instruction is a process of supporting the construction of knowledge (Duffy & Cunningham, 1996; Jonassen & Reeves, 1996). Constructivism learning environment requires students to actively generate knowledge rather than passively accept knowledge. Students are active in the learning process and engage in knowledge construction for the learning based on a constructivist approach (Jonassen, Mayes & McAleese, 1993).

According to DeLone and McLean (2003), individual's use of systems is an important determinant to measure IS success. Technology Acceptance Model (TAM) has been widely applied to studies of technology acceptance and usage behavior (Bruner & Kumar, 2005). In TAM, technology acceptance and actual usage is determined by behavioural intention (BI). BI in turn, is affected by perceived usefulness (PU) and perceived ease of use (PEOU), as well as the direct and indirect effects of external variables (computer self-efficacy, training, cognitive absorption and intrinsic motivation).

The effectiveness of the learning system that integrates collaborative learning and generative learning strategies as well as learning object design is evaluated in terms of students' perception and performance. The performance of students is assessed based on their pre-test, post-test and knowledge constructed mean score.

1.11 Research Framework

The research framework of this research study is illustrated in Figure 1.2. The research activity consists of three phases, namely '*(i) input*', '*(ii) process*' and '*(iii) output'*. In '*(i) input*' phase, there are course activity, learning object and content organiser. Course activity consists of learning outcomes, learning objectives, learning content of each topic and assessments. Learning objects can be in the form of html web page, pdf file, word document, graphic file, animation file, audio file or video file. Content organiser was used by students to construct their own knowledge and meaning in the form of lesson maps.

In '*(ii) process*' phase, students use the CCO learning system for collaborative learning activity (collaboration and interaction process via asynchronous forum or synchronous chat room). They also use the learning system to

perform the generative learning activity (knowledge construction process by generating link between new and old knowledge) by generating the relationship between the learning objects.

In '*(iii) output*' phase, the effectiveness of the CCO learning system is evaluated. To answer Research Question 1, survey questionnaires with five points Likert-type scale were administered online. Correlation and multiple regression analyses were conducted to hypothesise relationships of study variables that affect students' behavioural intention to use the learning system. For Research Question 2, pretest-posttest method was applied to assess students' learning performance. T-test analysis was carried out to compare the post-test mean score between control group and experimental group. Linear regression analysis was conducted to answer Research question 3 to examine the relationship between participation of students in collaboration and their achievement (post-test and knowledge constructed mean score). The grading system of knowledge constructed utilised a rubric with specific criteria and level of quality.

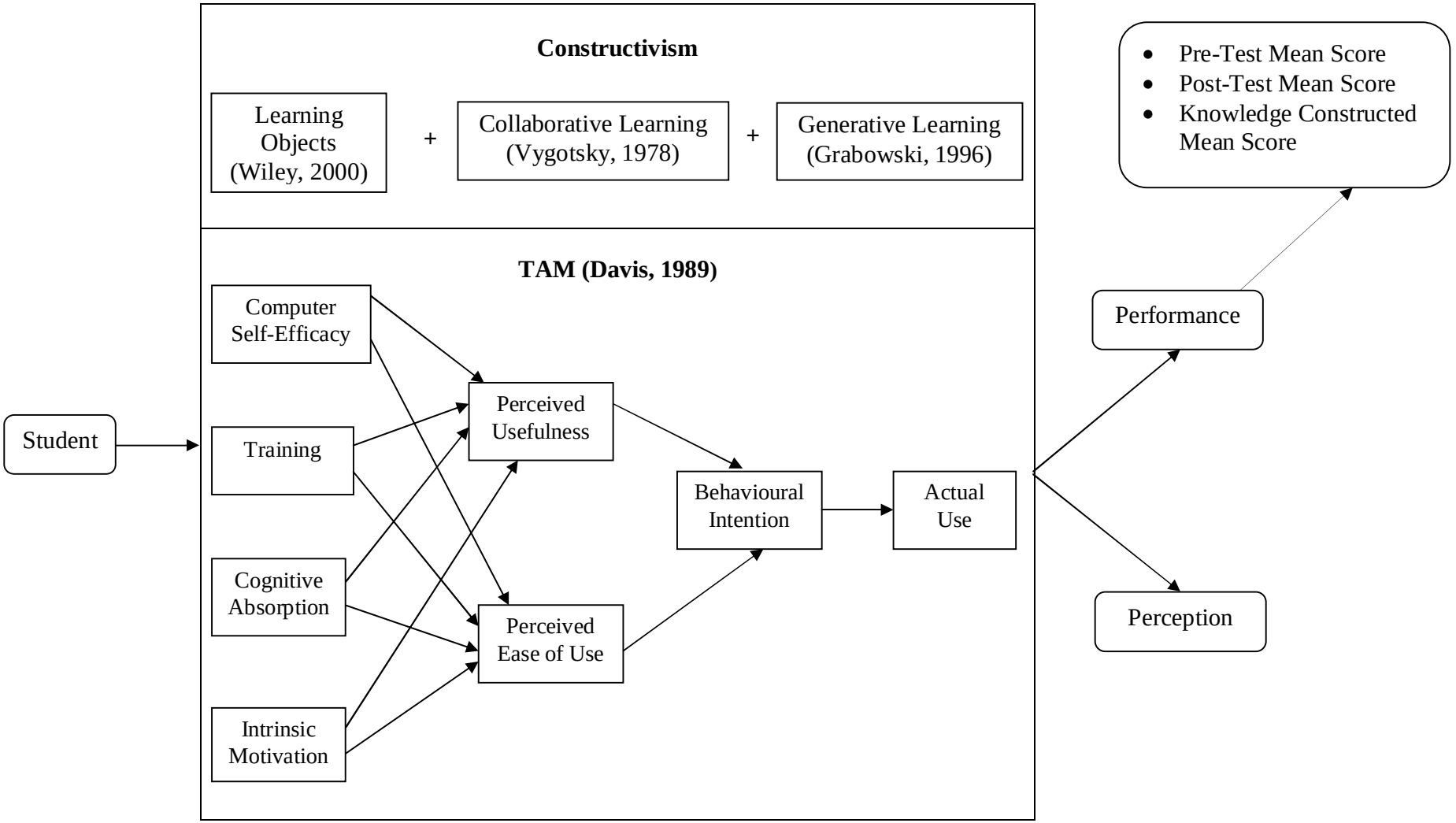

Figure 1.1 Theoretical Framework

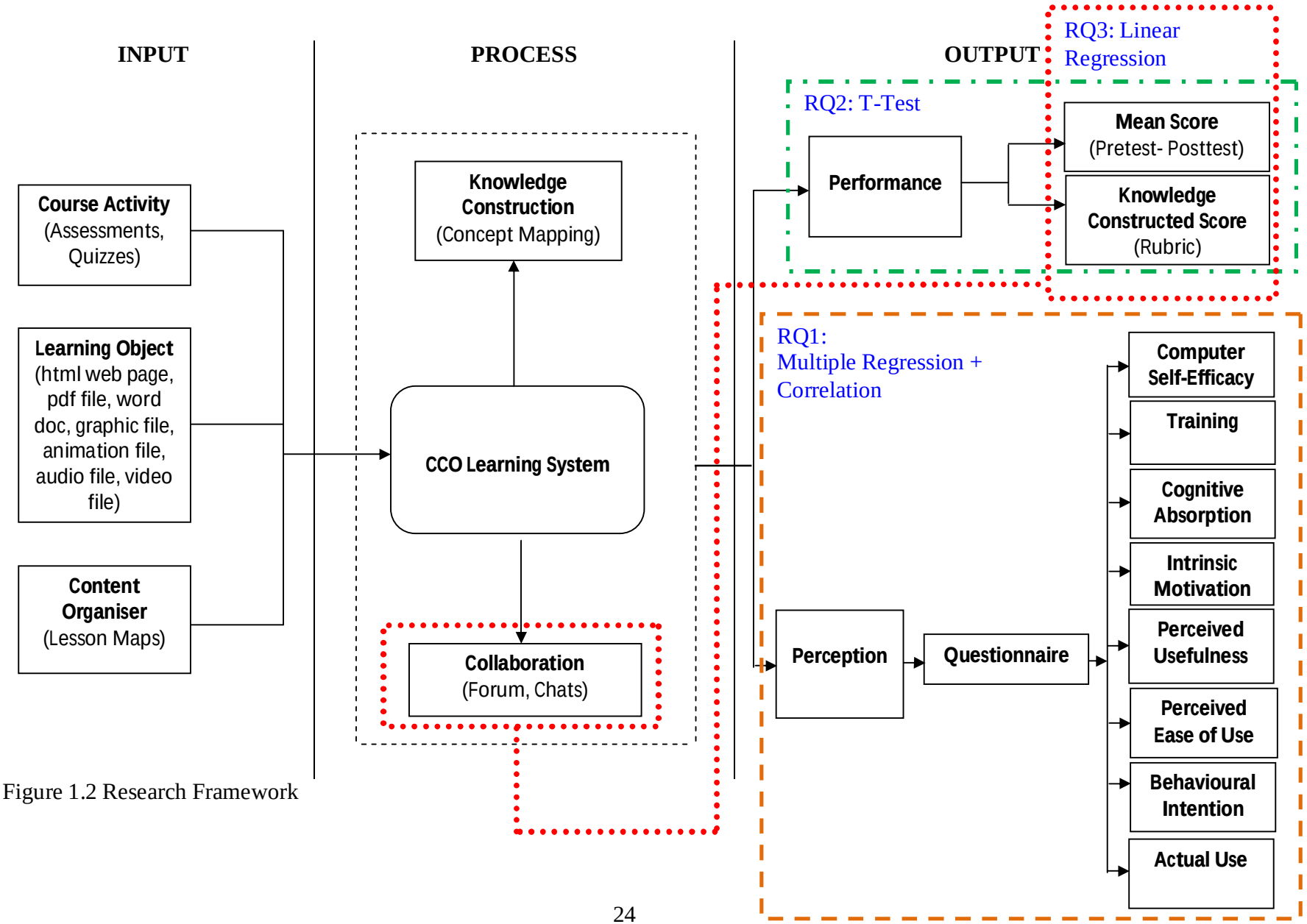

Figure 1.2 Research Framework