The effects of self-regulated learning strategies and system satisfaction regarding learner's performance in e-learning environment

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Abstract

An e-learner's characteristics are very important variables with regards to educational performance and the e-learning environment.

This study suggests a research model, based on a successful e-learning model, which presents the relationship between e-learner's self-regulated learning strategies and the quality perception in LMS (learning management systems). This research model focuses on self-regulated learning strategies and satisfaction with the learning environment.

This learning environment consists of a learning management system, learning content, and interaction that are provided by e-learning. Especially, this study suggests that e-learner's self-regulated learning strategy is very important in e-learning performance. The validity of the model will be shown empirically.

Keywords

e-learning, LMS, self-regulatory efficacy, self-regulated learning strategy

Introduction

The sloan consortium online learning survey report (2004) showed that online learning is at historically high levels and has not reached a plateau in its annual growth rate of approximately 20%. The report also revealed that a majority of institutions of higher education say online learning is just as good as traditional classroom instruction, and it is believed that online learning will experience the same relative improvements as face-to-face instruction.

Many researchers stay on an exploratory study regarding explanations of variations in e-learning effectiveness (Wang, 2003). The tendency in educational engineering in introducing theoretical variables which explain e-learning effectiveness is insufficient except for a few information systems (Piccoli et al., 2001). Moreover, this approach of putting together information systems and educational engineering is rarely observed.

This research investigates the theoretical background of pedagogical e-learning. It closely examines the relationship between information systems success models and e-learning. In addition, it suggests as well as verifies new research models that assess or evaluate e-learning effectiveness, based on models of educational engineering variables and information systems, which can be verified theoretically or empirically. Moreover, this study suggests that a learner's self-regulated learning strategy is a very important variable which is related to the e-learner's scholastic performance.

Theoretical background

Self-directed learning

The teaching-learning method in distance learning is assumed to be self-directed learning (SDL), which is supported by the educational philosophy of constructivism. According to constructivism theory, e-learning is an active information process because knowledge generation is accomplished through individual experience, maturity and interaction with one's environment. Due to this point of view, the educational philosophy of constructivism is distinguished from objectivism in that the learner is regarded as a passive recipient of information (Rovai, 2004).

Learning performance in regards to e-learning is possibly lower than a crammed educational style based on objectivist educational philosophy, with the exception of a strategic approach relating to the efforts and studies for the pleasure of the self-learner. The SDL teacher is available as an assistant and guide for learning, not as a unilateral knowledge source and messenger (Lee et al., 2008).

Learners take the lead in self-regulated learning for the development of a total learning process that involves problem perception, adoption, and assessment of alternatives (Kang, 1999). Learners play the same roles that the producers do by organizing or re-organizing knowledge like a consumer, by selecting knowledge and using it practically (Maddux & Johnson, 1997; Westera & Sloap, 1998).

E-learning must be considered as one of many SDL strategies. The reason is that an e-learner attends a lecture only to register the time, place, subject, and to alter the order of attending lectures. Proper monitoring of the learner is difficult in

comparison with the off-line education already being used, not only because the learning progress method of evaluation is being altered, but because personal meetings with the teacher are also no longer part of the process. Therefore, it is important to manage one's ability to organize self-learning time, process information, plan data, and control data.

Self-regulatory efficacy and self-regulated learning strategy

According to the cognitive psychology theory, self-regulatory efficacy (SRE) is defined as the efficacy of well-performed self-regulatory mechanisms such as self-observation, self-judgment, and self-response. Self-observation is defined as intentionally concentrating on various aspects. It provides information based on evaluating one's work as well as setting goals, relates to self-regulatory functions in order to assess the degree of task progress, and leads to behavior changes. Self-judgment compares the learner's goals to his or her present performance. It is determined by affinity or negativity according to a criterion adapted and based on judgment, character of goal, and significance of self-achievements based on one's purpose (Bandura, 1986).

In addition, self-response is explained by motivating oneself to change and control behavior according to the satisfaction of goal progress. The learner's independent assessment of self-regulated learning ability is called self-regulatory efficacy (SRE; Bong, 1998). Self-response is also measured by one's self-confidence in mastering a subject as high as a SRE's learner is willing to attain. Confidence promotes learning performance through the promotion of individual goals such as traditional education psychology (Bandura, 1997).

Self-regulated learning is required for academic performance completed through SDL. Self-regulated learning is defined as a learner's intended effort toward learning subjects (Corno & Mandinach, 1983). In addition, it is a systematic management process regarding one's own thoughts, emotions, and behavior regarding one's personal goals and achievements (Schunk, 2000).

In regards to self-regulated learning strategies, Zimmerman and Martinez-Pons (1988) reported on the correlation between self-regulated learning strategy and the person's grades in Mathematics and English. As well, Zimmerman, Bandura, and Martinez-Pons (1992) researched the causes and consequences of studying roles to self-efficacy. Zimmerman and Bandura (1994) also reported on the correlation between self-efficacy and self-regulated learning strategy. Zimmerman and Martinez-Pons (1986) developed an integrated strategy, based on a self-regulated learning strategy, including self-testing, organizational transformation, goals and planning, pursuing information, recording and checking, structured environment, strength, demonstration and memory, seeking help, and reviewing strategy. Their opinions are very important in e-learning environment.

According to self-regulated learning principles, the learner uses the strategic relationship between self-regulation and learning to reach his or her chosen self-learning goal, and to develop, revise, and complement the learning strategy via self-

feedback. Therefore, the learner must make a constant effort to sustain learning motivation (Zimmerman, 1990).

Information systems success model and learning management systems

DeLone and McLean (1992) suggested the information systems success (ISS) model that is measured through six dimensions: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. Furthermore a perceived usefulness (PU) suggested by Davis (1989) with technology acceptance model (TAM). And, Seddon and Kiew (1997) replaced the perceived usefulness with use concept.

Information quality is defined as a quality of system outputs of the product, and the usage and user satisfaction is defined as the recipients' interaction of information and information system product (Shannon and Weaver, 1949; Mason 1978; DeLone and McLean, 1992; Lee J. K. and Lee W. K., 2007).

The effects on e-learning are measured with an ISS model because it is also one of the information systems. The e-learning success model (ELS; Lee, 2004) evaluates e-learning effectiveness based on an ISS, constructivism, and self-regulatory efficacy. The learning management system (LMS) is applicable to the information process system that processes learning content and supports all matters related to other learning. Learning content is the product created through LMS in the ELS model. The interaction between teacher and students is applicable to the human service process in the ELS model (Lee, 2004).

In student learning, LMS can be a critical factor in e-learner satisfaction, because the subjects can be given through e-learning system. In addition, LMS discharges its transmission duties through a variety of learning content and unique forms are offered for each and every lesson. From a traditional view point, this is similar to the logic that classrooms and educational facilities transfer educational content having an effect on learner's satisfaction is not related to attending lectures of a given subject (Lee, 2004).

Learning content has different qualities according to each lecturers or producer's ability or character. Therefore, learning content is an important assessment factor and it is a direct criterion in deciding a learner's satisfaction, unlike learning management systems. It is similar logic that direct factors decide learner's satisfaction in the case of traditionally learned content. A learner may request human services to resolve a difficulty, an inconvenience or a technical problem that can occur when using the system, because LMS is one of many information systems. Of course, every e-learning organization should have a department that can resolve technical problems and sustain management separately (Lee, 2004).

Learners as users appeal to the teacher even for support for technical problems such as the usage of LMS, in addition to guidance and help about learning content. Therefore, teachers play a more important role than the staffs of a general information system department. This is similar to differences between serving staff and a head cook regarding the production of food. Guest confronts the general staff with their problems regarding food, and they resolve it (Lee, 2004).

In addition to an LMS is described as a highly generalized model (Chin-Ping Chu et al., 2004), consisting of seven parts: a tracking service; a delivery service; a learner profile service; a course management service; a content management service; a test/assessment service; and a sequencing service. These services provide the functionality of learner/learning tracking, content delivery, course import/export, and

content sequencing. The tracking service takes a learner request and traces the learning status of the learner, while the delivery service delivers the learning content to the learner.

Research model and hypothesis

Research model

This study suggests that a research model as in Figure 1. It is a modification of an information systems success model, and it considers an information system's attributes and self-regulated learning attributes. In addition, it supports education engineering in e-learning. This model is composed of independent variables, such as perceived usefulness regarding LMS, satisfaction of learning content (ICQ, IRQ), and interaction between teacher and learner (SQ). Also, self-regulated learning strategy has an effect on the learner's performance. The dependent variable is the academic performance of the learner after experiencing e-learning.
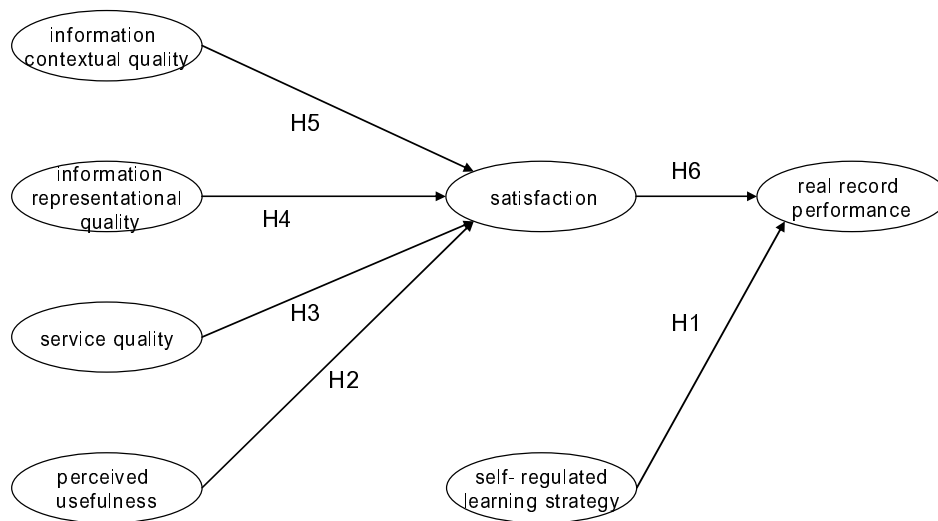
Figure 1 research model

Hypothesis

ISS model and self-regulated learning strategy

According to consumer behavior theory, satisfaction is measured through a customer's response regarding fulfillments, and customer judgment regarding products or services. Satisfaction also includes the fulfillment of one's performance (Oliver and Swan, 1989). For judgment, fulfillment of one's performance is required as a reference that is to be compared with a standard. References are needed to be compared with results or outcomes in order to judge satisfaction (Au, et al., 2002).

In an information system, consumers or customers of consumer behavior theory refer to users who utilize the system directly, unless they have a technical background (DeLone and McLean, 1992; Au et al., 2002). Similar to consumer behavior theory, an end-user's satisfaction is a user's attitude toward a specific computer application system which they utilized (Doll and Torkzadeh, 1988). Satisfaction can also be justified by the perceived or emotional assessment regarding fulfillment level referring to experienced performance via the information system (Au et al., 2002). E-learning is also regarded as an information system. E-learning satisfaction should correlate with end user based on information system satisfaction. Learning is compared with a traditional, brick and mortar course. Satisfaction for e-learning and assessment of the information system are compared with consumer behavior theory. Traditionally, in the field of information systems, it has been assumed that user's information system satisfaction obtained a higher level of performance than that of unsatisfied users (Bailey and Pearson, 1983).

It is inferred that for e-learning, a learner's satisfaction will be positively related to academic performance. In self-regulated learning, the learner uses a strategic relationship between self-regulation and learning in order to reach his chosen self-learning goal, and to develop, revise, and complement the learning strategy via self feedback. The learner must make a constant effort to sustain learning motivation (Zimmerman, 1990). From these points of view, the following hypothesis can be put forth:

Hypotheses-1 (H1): A learner's self-regulated learning strategy in e-learning will be positively related to the scholastic performance of an e-learner.

Quality of the e-learning environment.

According to the information systems success model, system quality measures the information system process itself and it's effect on user satisfaction (DeLone and McLean, 1992). System quality implies accuracy and efficiency according to the communication theory based information systems success model (DeLone and McLean, 1992). With regard to information system theory, system quality is based on how easily a user can deal with the system (Doll and Torkzadeh, 1988; Rai et al., 2002). It is acknowledged that system quality in information systems success model is substituted for perceived ease of use (Seddon and Kiew, 1997; Rai, et al., 2002). Perceived ease of use can be justified as the perception of how much effort is needed in

using a system, which is an important variable in attitudes toward information systems (Davis, 1989; Davis et al., 1989).

LMS is one of many information systems used by learners. Perceived usefulness for LMS has an effect on satisfaction toward a learning environment. Therefore, this study suggests the following hypotheses:

Hypotheses-2 (H2): A learner's perceived usefulness toward a learning management system will be positively related to e-learner satisfaction.

In addition, e-learning environmental satisfaction includes LMS, learning content and the service quality of interaction. Also the satisfaction is estimated by perceived usefulness and perceived ease of use.

Hypotheses-3 (H3): A learner's assessment of the service quality of interaction between a professor and learner will be positively related to e-learner satisfaction.

However, information quality is defined whether or not it is agree with the processing business. Also, information quality is composed of contextual quality, representational quality, and other components (Lee et al., 2002; Lee J. K., 2004). Furthermore, the content representational quality and contextual quality of LMS are very important variables in regards to e-learner satisfaction levels. Therefore, this study suggests the following hypotheses:

Hypotheses-4 (H4): A learner's assessment for content representational quality will be positively related to e-learner satisfaction.

Hypotheses-5 (H5): A learner's assessment for content contextual quality will be positively related to e-learner satisfaction.

In addition, Successful SRE learners will be concerned with the substance and quality of the learning content more than unsuccessful SRE learners. Lower SRE learners will be interested in easily accessible information and focused understanding. Lower SRE learners will prefer methods about a given learning content (Lee, 2004). According to Thatcher and Pamela (2002), personal innovativeness in information technology has an effect on computer self-efficacy. Also, Gatian (1994), there is a powerful relationship among user satisfaction, decision-making performance, and efficiency. Also, in the information systems success model of DeLone and McLean (1992), satisfaction was an effective variable regarding working efficiency or the decision-making level. Therefore, this study suggests the following hypotheses:

Hypotheses-6 (H6): A learner's satisfaction will be positively related to the scholastic performance of an e-learner.

Research methods

Students enrolled in e-learning courses at Daegu University responded to a poll in the first semester of 2005. The participating students took cyber courses in 3 different subjects offered at the above Universities, and 230 copies of an analysis questionnaire were collected. The survey was conducted from the 25th April to the 9th May 2005.

The analysis was designed with PLS (partial least square) method and used PLS Graph 3.0 software (Chin, 1998). PLS requirements for sample size are nor strict. The reason is that the approaches because it is based on components (Chin, 1998).

Sample distributions are illustrated in Table 1.

Table 1 Demographics

Item		Frequency	Percent (%)
Gender	Male	121	52.6
	Female	109	47.4
Grade	Freshman	10	4.3
	Sophomore	62	27.0
	Junior	54	23.5
	Senior	104	45.2
Major	Cultural science	93	40.4
	Social science	79	34.3
	Natural science	30	13.0
	Engineering	24	10.4
	Art and physical	4	1.7
E-learning career	First	145	63.0
	2 times	50	21.7
	3 times	25	10.9
	4 times and above	10	4.4
Classification of course study	Cultural subjects	36	15.7
	Subject of special study	145	63.0
	Subject of professorship	5	2.2
	2 subjects and above	44	19.1
Computer use time (1day)	Less than 1 hour	18	7.8
	1-2 hours	96	41.7
	2-6 hours	94	40.9
	6-12 hours	19	8.3
	12 hours and above	3	1.3
e-learning time (1 week)	Less than 1 hour	5	2.2
	1-2 hour	122	53.0
	3-4 hour	80	34.8
	5-7 hour	17	7.4
	8 hours and above	6	2.6

This study used the Likert 5-point scale and used the following measurement tools.

For perceived usefulness of LMS, it is used five edited items suggested by Davis et al. (1989). In the case of information quality (ICQ, IRQ) for learning content, used eight items suggested by Lee et al. (2002). Regarding service quality, it is used seven items suggested by Kettinger and Lee (1997). For e-learner satisfaction, it is used three items suggested by Wang (2003), for concerning scholastic performance, used one item according to the e-learner's academic real record.

Measurements are illustrated in Table 2.

Table 2 Measurement

Variables	Item	Researchers
Perceived usefulness	5	Davis et al.(1989)
Information representational quality	3	Lee et al.(2002)
Service quality	7	Kettinger & Lee(1997)
Information contextual quality	5	Lee et al.(2002)
Self-regulated learning strategy	4	Zimmerman et al.(1986)
Satisfaction	3	Wang(2003)
Real record	1	Real Record

Analysis

Construct reliability is proven as shown in Table 3, and correlations of latent variables are shown in Table 4. The suggested measure model is estimated as a good discriminate validity. Each hypothesis is accepted with the exception of H6. Figure 2 shows each analysis result.

Table 3 Convergent validity analysis

Construct	Item	Factor loading	Composite reliability	AVE	Cronbach's alpha
Service Quality	SQ1	0.843	0.895	0.552	0.906
	SQ2	0.829			
	SQ3	0.803			
	SQ4	0.749			
	SQ5	0.685			
	SQ6	0.650			
	SQ7	0.638			
Perceived Usefulness	PU1	0.787	0.852	0.536	0.864
	PU2	0.760			
	PU3	0.736			
	PU4	0.688			
	PU5	0.688			
Information Contextual Quality	ICQ1	0.749	0.801	0.447	0.829
	ICQ2	0.707			
	ICQ3	0.642			
	ICQ4	0.639			
	ICQ5	0.624			
Self-regulated Learning Strategy	SRS1	0.772	0.788	0.484	0.744
	SRS2	0.761			
	SRS3	0.658			
	SRS4	0.590			
Information Representational Quality	IRQ1	0.748	0.735	0.482	0.745
	IRQ2	0.728			
	IRQ3	0.665			
Satisfaction	SA1	0.725	0.640	0.373	0.712
	SA2	0.708			
	SA3	0.696			

Table 4 A correlations of latent variables

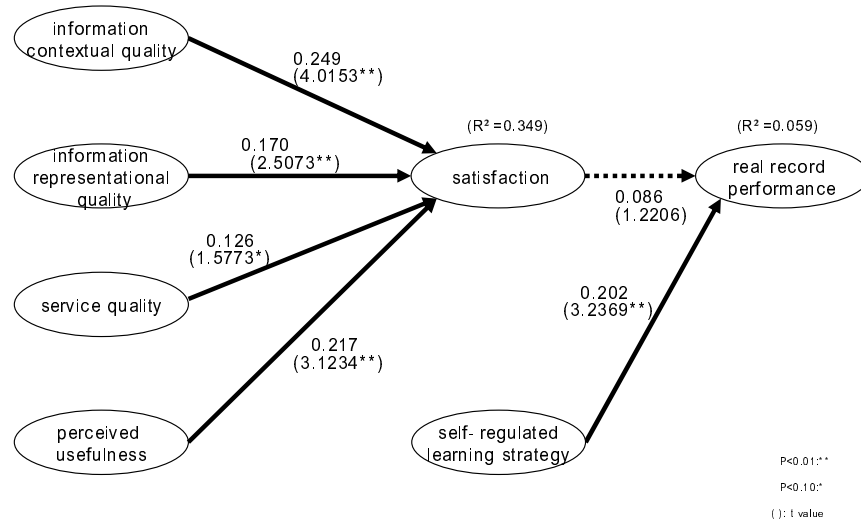|	ICQ	SQ	PU	SA	SRS	RR	IRQ
ICQ	1.000						
SQ	0.429	1.000					
PU	0.542	0.413	1.000				
SA	0.495	0.406	0.470	1.000			
SRS	0.414	0.416	0.303	0.315	1.000		
RR	0.108	0.169	0.082	0.150	0.229	1.000	
IRQ	0.441	0.495	0.388	0.426	0.439	0.076	1.000
MEAN	3.301	3.673	3.134	3.543	3.567	74.68	3.599
S.D.	0.969	1.056	0.876	1.079	0.993	13.72	0.960

Figure 2 PLS analysis result of the structure model.

The reason for the H4 (IRQ→SA) and H5 (ICQ→SA) path coefficient is explained through a survey of many learner's traits. It is not used to judge the consistency with which learning content agrees with a self-purposed learning context. Learners would memorize and understand transferred knowledge on one side from a professor. Furthermore, content representational quality and contextual quality of LMS are very important variables in e-learner satisfaction.

Also, the reason for the path coefficient of the H2 (PU→SA) is explained through the use of LMS which promotes extrinsic motivation. Extrinsic motivation is a behavioral response which corresponds to accomplishing one's objective or making remuneration through mastery of an activity. On the other hand, intrinsic motivation is a behavioral response which corresponds with the behavior itself (Deci, 1975).

According to Gefen and Straub (2000), it is known that perceived ease of use has less effect on information systems purpose, and it is not intrinsic motivation. The reason why information systems use extrinsic motivation is that learning occurs through LMS rather than learning itself. H6 (SA→RR) being rejected, however, has a very important implication. That is, a learner's scholastic performance can be influenced by many factors. An e-learner's satisfaction of LMS

is merely one factor in this study. An e-learner's satisfaction does not have an effect on scholastic performance in this paper.

In addition, an e-learner's real record in e-learning environment can be influenced by many variables like learner's characters. Relatively low value of real record R^2 in this research is one of the reasons like this. Above all, a learner's self-regulated learning strategy (H1, SRS→RR) is a more important variable than satisfaction regarding the real record in an e-learning environment.

Conclusions

This study suggests that it is important to find new things from a large cross-sectional study involving e-learner and learning management system. Especially, it is focused on information systems success and individual differences.

First of all, this study emphasizes strategy improvement of self-regulated learning strategy in e-learning. An e-learner's scholastic performance is more influenced by a learner's self-regulated learning strategy than by another learning management system satisfaction. In addition, further work concerning e-learner's self-regulated learning upgrade strategy is requested.

Second, e-learner's satisfaction requires quality assessments of teacher's interaction and system interaction. Many researchers have emphasized the importance of interaction or to the quantitative side of interaction, but they did not consider how to use this information. That is, they did not emphasize the assessment method for interaction quality. Interaction quality has had a significant effect on learner's satisfaction, as shown in this study. This study has suggested the importance of qualitative assessment and interaction through LMS.

Third, e-learner's satisfaction requires information contextual quality and information representational quality by learning management systems. That is, information contextual quality and information representational quality through LMS, learning content qualities, are very important regarding an e-learner's satisfaction.

Forth, this study suggested a model that can measure e-learning effectiveness and decided that an interdisciplinary method was needed, in view of web based information systems. The education engineering theory, which is based on constructivism education philosophy, as well as the service management theory, is composed of service related learning functions and technology. This study suggested a theory model to assess e-learner's satisfaction with e-learning based on LMS, and by adopting self-regulated learning strategy.

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