

FACTORS INFLUENCING LEARNERS' SELF-REGULATED LEARNING SKILLS IN A MASSIVE OPEN ONLINE COURSE (MOOC) ENVIRONMENT

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ABSTRACT

The importance of self-regulation in a MOOC has been extensively discussed in research studies that provide evidence about the significant relationship between self-regulated learning and success in an e-learning environment. Learners with high self-regulated learning are more independent in regulating their learning and have a greater probability of success in their online courses. This study identifies factors that influence self-regulated learning and determines relationships between these factors and self-regulated learning. A conceptual model is proposed for combining success factors for self-regulated learning in a MOOC environment. A research instrument based on the model was designed and administered to six hundred and twenty-two MOOC students enrolled in five universities. Relationships between relevant factors and self-regulated learning were examined using a Partial Least Squares Structural Equation Modeling (PLS-SEM) technique, and the statistical findings revealed that three factors - service quality, attitude, and course quality - influence self-regulated learning in a MOOC.

Keywords: MOOC, Massive Open Online Courses, self-regulated learning, MOOC success.

INTRODUCTION

A Massive Open Online Course (MOOC) is a new phenomenon in e-learning sector that has substantial capability to provide free online courses to a huge group of learners around the world. MOOC contributes to improvement of educational institutions (Mazoue, 2014) by allowing learners to effectively exchange knowledge and experience through collaborative learning. MOOC offers several features such as interaction, self-reflection, collaboration, and evaluation that support learning experiences (de Waard et al., 2014).

Despite the growth in MOOC implementation, there are some issues surrounding its successful implementation in higher education contexts; one such issue is the high dropout rate among MOOC learners (Parr, 2013). Research studies (e.g. Alraimi, Zo, & Ciganek, 2015; Hew & Cheung, 2014) have indicated that completion rates in MOOC courses could be less than 10%, and such high dropout rates have occurred across multiple institutions. The Massachusetts Institute of Technology (MIT), for example, established its first MOOC in 2012 with a total of 155,000 students enrolled, experienced a dropout rate of more than 95 %, meaning that only 7,000 out of 155,000 students successfully completed the course (Daniel & Uvalic-Trumbic, 2013). Such a high dropout rate obviously reflects an unsuccessful implementation of MOOC at the institutional level.

Since the literature strongly indicates that the high dropout rate in online learning courses may be due to a mix of factors associated with courses, services, and educational quality (Alsabawy, Cater-Steel, & Soar, 2012), understanding the factors that affect MOOC success is critical and careful consideration of these factors could help improve the effectiveness of implementing MOOC and diminish its failings (Alsabawy et al., 2012; Authors, 2018), especially for MOOC stakeholders, administrators, managers and scholars (Alsabawy, Cater-Steel, & Soar, 2011).

Current MOOC literature has described the important role of learners' self-regulated learning (SRL) skills in accomplishing MOOC success (e.g. Hood, Littlejohn, & Milligan, 2015; Littlejohn & Milligan, 2015; Terras & Ramsay, 2015). MOOC provides learners with powerful self-regulated learning skills (i.e., time management and effort regulation) to promote learning, particularly self-directed learning (Kizilcec, Pérez-Sanagustín, & Maldonado, 2016; Magen-Nagar & Cohen, 2016). This leads to a high degree of self-regulation that in turn leads to greater engagement within learning via MOOC and makes students more likely to succeed in their learning (Kizilcec, Pérez-Sanagustín, & Maldonado, 2017; Liaw & Huang, 2013). Adopting from the DeLone & McLean Information System model (2003), this study extends the current literature by examining five (5) major factors that influence learners' SRL skills. The five factors are: (1) system quality; (2) information quality; (3) service quality; (4) attitude; and (5) course quality. Understanding the influence of each of these factors is important to support building a successful operational framework of MOOC success factors.

AIM OF THE STUDY

This study aims to combine the MOOC success factors for self-regulated learning in a proposed model based on the D & M (2003) model, and to identify the relationships between these factors and SRL. It also seeks to offer interested researchers scientific results related to self-regulated learning skills in MOOC environments. Within this perspective, the research objectives for this study are as follows:

1. To determine the key factors that influence self-regulated learning in MOOC; and
2. To determine the relationships between the factors in the proposed model.

This study has been guided by the following research questions:

1. What are the key factors influencing self-regulated learning in MOOC?
2. What are the relationships between 5 success factors (i.e. system quality, information quality, service quality, student attitude, course quality) and learners' self-regulated learning?

SIGNIFICANCE OF THE STUDY

This study intends to contribute to a better understanding of MOOC literature by highlighting the factors influencing self-regulated learning and combining them into a framework based on the D & M (2003) model to guide researchers, educators, and instructional designers to develop effective MOOC environments that can effectively support learners self-regulated learning skills and subsequent success in MOOC.

LITERATURE REVIEW

Self-Regulated Learning

The concept of self-regulated learning relates to how individuals manage their personal learning processes, especially how to monitor, regulate, and evaluate their own learning, and plan learning actions and behavioral processes that increase likelihood of goal attainment (Zimmerman, 2015).

Self-regulated learning has received great attention in the online learning literature (Cho & Kim, 2013; Terras & Ramsay, 2015; Zhao, 2016). In these studies, the vital role of self-regulated learning with respect to learner behavior online was highlighted, and the influence of self-regulation on promoting success in online learning environments was revealed (Cho & Kim, 2013; Terras & Ramsay, 2015). Student success in e-learning clearly requires effective use of self-regulated learning strategies (Barnard-Brak, Paton, & Lan, 2010).

Cho and Shen (2013) examined the role of self-regulation skills and found that since learners with a high level of self-regulation are more independent learners in regulating their learning thus, their probability of success in online courses is greater. Self-regulation skills contribute to supporting learners' engagement and improve learning strategies achieved through instructional interventions and practice in implementing the self-regulated learning process. Self-regulated learning skills can enhance learners' ability to regularly

review their material, to effectively manage their time, to seek assistance from peers or instructors, and to provide the required metacognition skills that reflect their own learning (You & Kang, 2014). Self-regulated learning (SRL) contributes to develop learners' skills related to being active learners in obtaining the required knowledge and improving their personal steps toward mastering that knowledge. Enhanced self-regulated learning skills help learners to find the best solutions for challenges or obstacles facing them, thus achieving their learning goals and succeeding in their learning process. Broadbent and Poon (2015) indicated that highly self-regulated learners exhibit effective positive motivation and self-efficiency with respect to their own learning processes through such activities as selecting learning content, identifying learning goals, and organizing and controlling their learning processes.

Conversely, not all students have the motivation required to organize their online course activity, and not all of them are able to effectively regulate their online learning. Many studies have identified the lack of SRL skills among participants involved in online learning settings (Kizilcec & Halawa, 2015; Lee, Choi, & Kim, 2012; Nawrot & Doucet, 2014). For instance, Lee et al. (2012) argue that students without the ability to manage their own online learning will face difficulties and this may hinder their success in online courses. The literature indicates that learners with low self-regulation skills would be less likely to achieve success in the e-learning field (Cho & Shen, 2013; Kizilcec & Halawa, 2015). You and Kang (2014) highlighted that lack of self-regulation skills in e-learning environments may result in learners consuming extra time in completing the assignments, causing turning in late assignments or generally poor-quality work. Nawrot and Doucet (2014) also indicated that lesser student experience with regulating their own learning (such as poor time management) can lead to increase in course withdrawal, frustration, and consequently poor academic outcomes.

MOOC and Self-Regulated Learning

MOOC is a platform for communication and collaboration in which participants exchange information to enhance their knowledge (de Waard et al., 2014). Many MOOCs have been designed to encourage learners to regulate their learning all by themselves rather than depending on instructor guidance. Since MOOC learners can independently select learning resources and choose to participate in activities (Davis, Chen, Jivet, Hauff, & Houben, 2016), they may require learners to regulate their learning while using MOOC. Previous research suggests that MOOC learners with highly self-regulated learning exhibit different cognitive, affective, and behavioral reactions toward learning in MOOC than those who exhibit lower levels of self-regulated learning (Hood et al., 2015; Littlejohn & Milligan, 2015). It is clear that MOOC success requires high levels of self-regulated learning (SRL) skills, but at present not much research is available on how to support self-regulated learning skills in a MOOC environment (Onah & Sinclair, 2017).

There is also growing evidence that MOOC has significant potential to support student self-regulated learning (Littlejohn, Hood, Milligan, & Mustain, 2016). Since MOOC learners must be independent and active participants in the learning process, those with higher self-regulated learning skills exhibit more ability to engage in learning by individually setting learning objectives, identifying the effective learning techniques, and monitoring the processes of achieving their objectives (Kizilcec et al., 2016). Unfortunately, many groups of MOOC learners continue to struggle with self-regulating their learning (Milligan, Littlejohn, & Margaryan, 2013). Consequently, because of the importance of SRL skill in MOOC system success and the rarity of available studies about the relationships between MOOC and student self-regulated learning, this study examines SRL as a dependent factor and investigates the factors that influence SRL in a MOOC environment.

THEORETICAL FRAMEWORK

DeLone and McLean Model

The DeLone and McLean model is considered one of the most important models contributed to assessment of e-learning systems success (Alsabawy et al., 2011). The model hypothesizes that factors of information quality, system quality, and service quality all have positive influence on user satisfaction and use/intention to use particular systems. Figure 1 the displays DeLone and McLean (2003) model.

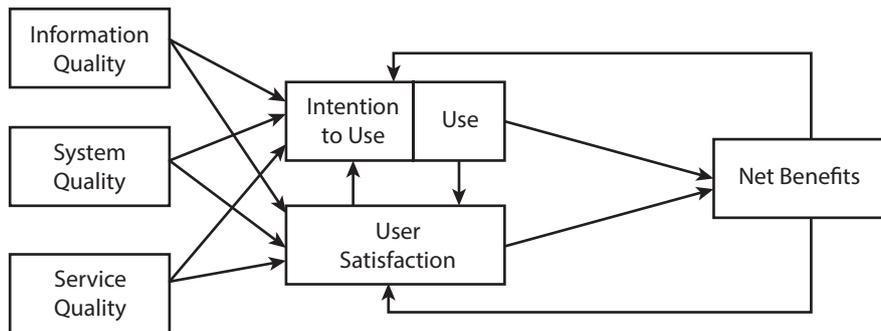


Figure 1. DeLone & McLean (2003) model.

System quality relates to how well the hardware and the software work together; in other words, it refers to the effectiveness of processing system information (DeLone & McLean, 2003). Information quality is related to measurement of the quality of information created by a system (Petter, DeLone & McLean, 2008) while service quality refers to the level and manner in which services are provided by the information system sector or system providers (DeLone & McLean, 2003).

Many studies (e.g., Freeze, Alshare, Lane, & Wen, 2010; Hassanzadeh, Kanaani, & Elahi, 2012; Tella, 2011; Wang & Chiu, 2011) have tested the validity of DeLone and McLean's model. Some of these studies adopted DeLone and McLean's model in its entirety while others partially tested the model by examining some of its specific factors. Some studies, on the other hand, extended the DeLone and McLean model by including other external factors to achieve deeper understanding of system success.

Because of the vital role of self-regulated learning skills in e-learning environments, many studies have indicated that a self-regulated learning factor should be considered as a principal dimension in evaluating systems success, so Lee and Lee (2008) modified the D & M model by adding self-regulated learning as a moderating variable. Zhao (2016) also proposed a new learning system success model in the particular context of e-learning 2.0. This model reframes the original D & M model by adding communication quality and replacing net benefit with self-regulation as dependent variables, as shown in Figure 2.

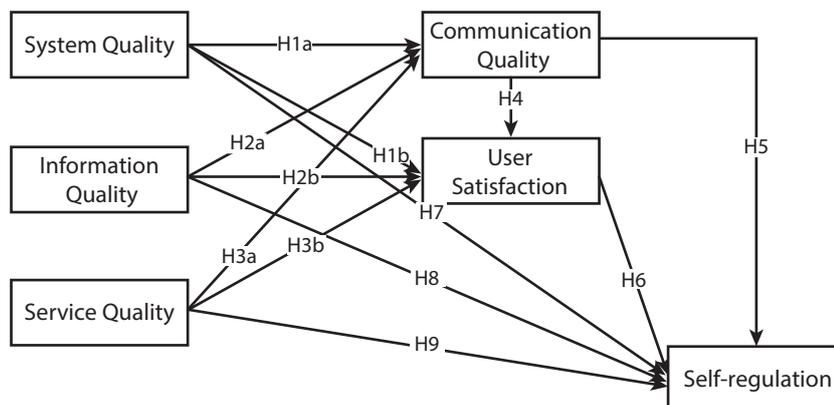


Figure 2. Modification of DeLone & McLean (2003) model by Zhao (2016).

Research Model and Hypotheses

Samarasinghe (2012) indicated that there are insufficient dimensions in the D&M (2003) model to measure system success and cover all of the relevant e-learning success features, so he recommended inclusion of other significant factors related to both learners and courses in the model.

This study therefore proposes a model that includes a total of six variables: information quality, system quality, service quality, course quality, attitude, and self-regulated learning. Arrows can be used to denote proposed relationships among the six variables in the research model as shown in Figure 3.

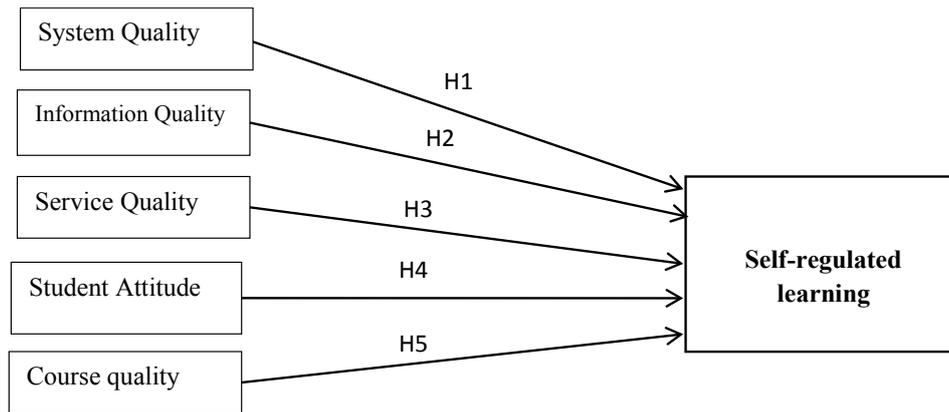


Figure 3. Research model

In this model, system quality refers to the degree to which learners perceive that a MOOC system is easy to use, easy to learn, has integrity, and is reliable. The second factor in this study, information quality, represents the quality and relevance of the information offered by MOOC systems. In other words, information quality refers to the ability of a MOOC to provide information that exactly meets learners' needs, is relevant to learners' job, is easy to understand, and is up to date. On the other hand, attitude refers to the set of learner beliefs in using MOOC regarding whether it is good or bad. Finally, course quality in this study refers to the extent to which a learner believes that a MOOC offers quality content.

Hypotheses

Barnard-Brak et al., (2010) defined self-regulated learning as voluntary behavior of an individual to measure his or her own success in learning. MOOC can enable learners to individually regulate their learning processes by promoting self-reflection, developing learning objectives, planning time use effectively, and managing skills (Onah & Sinclair, 2017). Some researchers (e.g., Littlejohn et al., 2016) have also discussed MOOC used to promote self-regulation skills. Learners with high self-regulation levels contribute to engagement within e-learning and are more likely to succeed in e-learning environments (Liaw & Huang, 2013; Zhao, 2016).

In a related study, Zhao (2016) examined factors influencing self-regulation skill in an online learning environment such as MOOC and revealed the three (3) main factors related to system success: system quality, information quality, and service quality. The following hypotheses are therefore proposed:

- H1:** *There is a positive relationship between system quality and learners' self-regulated learning in MOOC environment.*
- H2:** *There is a positive relationship between information quality and learners' self-regulated learning in MOOC environment.*
- H3:** *There is a positive relationship between service quality and learners' self-regulated learning in MOOC environment.*

Since many studies have shown that self-regulation is a critical factor affecting student attitudes toward e-learning (Kramarski & Gutman, 2006; Zimmerman & Schunk, 2001), H4 is also proposed.

- H4:** *There is a positive relationship between attitude and learners' self-regulated learning in MOOC environment.*

Lin, Lin, and Hung (2015) argue that the perceptions of learners toward the quality and richness of course content have significant influence with respect to accepting the knowledge provided. Rai and Chunrao (2016) noted the role of quality of course in MOOC systems success. Therefore, H5 is proposed.

- H5:** *There is a positive relationship between course quality and learners' self-regulated learning in MOOC environment.*

METHODOLOGY

Research Instrument

The questionnaire used in this research was gleaned and compiled various validated instruments from the literature reviewed on e-learning and MOOC but some modifications were made to wording to suit the context of this research. System quality and information quality factors were measured with a scale developed by Alsabawy et al. (2012) while service quality was measured by a scale developed by Ozkan, Koseler, and Baykal (2009). Course quality items were adapted from a study by Rhema and Miliszewska (2014) whilst self-regulated learning factor was examined by a scale for Onah and Sinclair (2017). Most of these studies employed the D & M (2003) model in their researches.

The research instrument is divided into two parts. Part 1 includes demographic information, including gender, age, and previous experience with MOOC, while the second part includes measurement items of the research model based on six constructs: system quality, information quality, service quality, attitude, course quality, and self-regulated learning. The questionnaire covered 41 items using a 5-point Likert scale ranging from “Strongly agree (5),” to “Strongly disagree (1)”.

Data Collection and Analysis

The questionnaire was administered to 1000 undergraduate students from the top active MOOC user universities in Malaysia. All participants had been enrolled in at least one MOOC course via the OpenLearning platform, the official MOOC platform in Malaysia.

From the total number of 1000 questionnaires administered, 622 valid questionnaires were returned, an effective response rate of 62.2 %. In the final sample population, 63.8% participants were females and 35.9% were males. The majority of the participants, 54.2%, were of ages between 20 and 30 years. With regard to participants' experience in MOOC, 41.3% of the participants had limited experience with a current MOOC course.

Data from the questionnaires were analyzed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique (Ringle, Wende, & Becker, 2015) because PLS-SEM enables researchers to acquire an accurate study model and is considered suitable for testing new models (Henseler, Ringle, & Sinkovics, 2009).

Reliability and Validity of the Proposed Model

The reliability of the questionnaire was measured using Cronbach's alpha (α), the most common indicator for internal consistency, an α value greater than 0.70 indicating good reliability (Hair et al., 2006). The data analysis revealed that the Cronbach's alpha for the items in the questionnaire was between 0.70 and 0.915, reflecting its high reliability.

Analysis of validity was then conducted using PLS-SEM analysis. Validity refers to the capability of the measurement items to effectively measure the intended constructs (Hair, Black, Babin, & Anderson, 2010). In this study, validity was measured in two stages: (1) analysis of the measurement model, and (2) analysis of the structural model (Hair, Ringle, & Sarstedt, 2011). The findings of these analyses are presented in the next section.

FINDINGS

Analysis of the Measurement Model

In the first stage, analysis of the measurement model was conducted by evaluating convergent and discriminant validity. Three indices were used to test convergent validity. First, by assessing factor loading, each item loading of the construct should be greater than 0.50 to achieve convergent validity (Hair et al., 2006). Second, the value of Average Variance Extracted (AVE) that should exceed 0.50 was tested. Third, the value of composite reliability (CR) of each item, that should be greater than 0.7, was examined (Hair, Hult, Ringle, & Sarstedt, 2014). The results of convergent validity determination for the questionnaire items are displayed in Table 1.

Table 1. The convergent validity results

Construct	Items	Measurement variables	Loadings	CR	AVE
Attitude	AT1	I feel confident in using MOOC.	0.800	0.934	0.639
	AT2	I enjoy using MOOC for my studies.	0.818		
	AT3	I believe that MOOC gives me the opportunity to acquire new knowledge.	0.778		
	AT4	I believe that MOOC enhances my learning experience.	0.817		
	AT5	I believe that convenience is an important feature of MOOC.	0.760		
	AT6	I believe that MOOC increases the quality of learning because it integrates all forms of media.	0.775		
	AT7	I believe that adopting MOOC allows for increased student satisfaction.	0.797		
	AT8	I believe that studying courses that use MOOC is interesting.	0.812		
	AT9	In my MOOC learning experiences, the courses content is up-to-date.	0.641		
Course quality	CQ1	In my MOOC learning experiences, learning outcomes for the course are summarized in clearly written, straightforward statements.	0.791	0.863	0.678
	CQ2	In my MOOC learning experiences, courses are designed to encourage learners to work together utilizing problem-solving activities to develop topic understanding.	0.833		
	CQ3	In my MOOC learning experiences, the course content is communicated well.	0.846		
Information quality	IQ1	I believe that MOOC system provides me with the outputs that I need.	0.783	0.881	0.649
	IQ2	I believe that information (i.e. learning materials) from the MOOC system is in a form that is readily usable.	0.822		
	IQ3	I believe that, MOOC system provides information (i.e. learning materials) that is easy to understand.	0.809		
	IQ4	I believe that information (i.e. learning materials) from the MOOC system is concise.	0.808		
System quality	SQ1	For me, the MOOC system is easy to use.	0.799	0.894	0.629
	SQ2	For me, the MOOC system is easy to manage.	0.806		
	SQ3	For me, MOOC system meets my expectations.	0.840		
	SQ4	For me, MOOC system includes necessary features and functions for my study.	0.812		
	SQ5	For me, all data within MOOC system is fully integrated and consistent.	0.701		
Service quality	SRQ1	In my MOOC learning experiences, the instructors are good to learners.	0.844	0.875	0.639
	SRQ2	In my MOOC learning experiences, the instructors are friendly to learners.	0.841		
	SRQ3	In my MOOC learning experiences, the instructors are knowledgeable enough about the content.	0.807		
	SRQ4	In my MOOC learning experiences, the instructors are available via e-mail, phone or fax.	0.696		
Self-Regulated Learning	SR1	I know what I am going to achieve in this MOOC course.	0.712	0.914	0.57
	SR2	I have set aside time to study the MOOC course.	0.727		
	SR3	I have high standards for my work on this MOOC course.	0.788		
	SR4	I have set targets for all I want to achieve in this MOOC course.	0.772		
	SR5	I have written down the goals I plan to achieve by the end of this MOOC course.	0.744		
	SR6	I work strategically to prioritize tasks to help me achieve my learning goals in MOOC course.	0.773		
	SR7	I am prepared to tackle any challenging aspects of the work in this MOOC course.	0.738		
	SR8	I have planned ahead in order to devote the necessary time to my online studies.	0.782		
	SR9	I find a good time to study when I won't be distracted.	0.774		
	SR10	I choose my study location in order to avoid distractions.	0.824		
	SR11	I find a comfortable place to study.	0.851		
	SR12	I choose an appropriate place to work in order to study effectively.	0.793		
	SR13	I plan to use the interactive communication channels provided to gain support from peers and tutors.	0.760		
	SR14	I plan to participate in the course discussion forums in order to get the most out of the course.	0.813		
	SR15	While engaging in this course, I will reflect on my study in each module.	0.849		
	SR16	I will be proactive in engaging and reviewing progress in the learning path I select.	0.808		

As shown in Table 1, the factor loadings for all factors were all higher than 0.6., and the AVE values were also above 0.5. The composite reliability (CR) for the factors were 0.8 and higher, suggesting good convergent validity.

Next, the discriminant validity of the model factors was established. Discriminant validity is the degree to which measurement items of a specific factor reflect that factor instead of other factors in the same model (Hulland, 1999). In this study, the new HTMT criteria using PLS was conducted to check for lack of discriminant validity. HTMT discriminant validity between two constructs is established when the HTMT 0.85 value is less than 0.85 (Kline, 2011), or HTMT 0.90 value is less than 0.90 (Gold, Malhotra, & Segars, 2001) when the confidence interval has a value of one (Henseler, Ringle, & Sarstedt, 2015). The Heterotrait-Monotrait (HTMT) Analysis is shown in Table 2.

Table 2. The Heterotrait-Monotrait (HTMT) Analysis

	AT	CQ	IQ	SRL	SRQ	SQ
AT						
CQ	0.836 CI.90 (0.786, 0.883)					
IQ	0.800 CI.90 (0.748, 0.894)	0.796 CI.90 (0.724, 0.862)				
SRL	0.715 CI.90 (0.662, 0.770)	0.758 CI.90 (0.693, 0.821)	0.651 CI.90 (0.575, 0.717)			
SRQ	0.650 CI.90 (0.572, 0.723)	0.754 CI.90 (0.682, 0.831)	0.746 CI.90 (0.684, 0.811)	0.652 CI.90 (0.583, 0.712)		
SQ	0.769 CI.90 (0.704, 0.822)	0.776 CI.90 (0.709, 0.837)	0.874 CI.90 (0.820, 0.922)	0.610 CI.90 (0.534, 0.676)	0.719 CI.90 (0.653, 0.783)	

Note: SQ: AT: attitude; CQ: course quality; IQ: information quality; SRL: self-regulated learning; SRQ: service quality; system quality.

The findings of the analysis revealed that there is no value of 1 for the confidence interval of the factors and all values passed the HTMT value of 0.90 tests. This result therefore showed no discriminant validity issues.

Analysis of the Structural Model

The purpose of this analysis is to confirm or reject the proposed hypotheses. Hair, Anderson, Tatham & Black (1998) noted that the structural model must involve set of relationships between factors of the hypothesized model. The structural model was evaluated according to the following criteria:

Coefficient of Determination (R²) and Predictive Relevance (Q²)

The R-square value (R²) indicates the amount of variance corresponding to the dependent variables while the quality of the structural model is evaluated using (Q²) to examine the predictive relevance for the structural model (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005). Table 3 displays the values of R² and Q².

Table 3. The values of R2 and Q2

Construct	Relationships	R ²	Result (R ²)	Q ²	Result (Q ²)
SRL	Attitude -> SRL	0.563	Moderate	0.220	Medium effect
	CourseQ -> SRL				
	InfoQ -> SRL				
	ServiceQ -> SRL				
	SystemQ -> SRL				

According to Table 3 the R2 value is 0.563, meaning that all five factors (system quality, information quality, service quality, attitude, and course quality) explain 56.3% of the variance in self-regulated learning. Since the value of R2 = 0.563 was between 0.67 and 0.33, a moderate model is suggested (Chin, 1998).

The Q2 analysis applies to the endogenous constructs that represent reflective measurement (Hair et al., 2014). Hair et al. (2014) noted that a Q2 value greater than zero showed that the model has sufficient predictive relevance for the endogenous construct. Table (3) showed that the model has adequate predictive relevance because the Q2 values for SRL (Q2=0.220) > 0 and also displayed medium predictive relevance where SRL (0.220 > 0.15) (Hair et al., 2014).

Path Coefficients

Path coefficients indicate the strength of a relationship between two variables in the structural model (Cohen, 1988). In this section, a Bootstrapping technique with 5,000 resamples was used to obtain a resulting beta (β) value and t-values and to evaluate the significance of the hypotheses of the study as recommended by Chin, Marcolin, and Newsted (2003). Table 4 displays the bootstrapping results.

Table 4. Bootstrapping result and hypotheses testing

Hypotheses	Relationship	Std Beta	Std Error	t-value	p-value	Supported
H1	SystemQ -> SRL	-0.094	0.054	1.751	0.081	No
H2	InfoQ -> SRL	0.078	0.050	1.578	0.115	No
H3	ServiceQ -> SRL	0.168	0.044	3.842**	000	Yes
H4	Attitude -> SRL	0.328	0.047	7.001**	000	Yes
H5	CourseQ -> SRL	0.205	0.048	4.305**	000	Yes

Note. (t-values > 1.645* where $p < 0.05$), (t-values > 2.33** where $p < 0.01$)

Referring to Table 4, the predictors of self-regulated learning: service quality ($\beta = 0.168$), attitude ($\beta = 0.328$), and course quality ($\beta = 0.205$) were all significantly associated with SRL ($p < 0.01$), so H3, H4, H5 were supported. System quality ($\beta = -0.094$) and information quality ($\beta = 0.078$) were not significant ($p > 0.05$), so H1 and H2 were not supported.

Effect Sizes (f 2)

Effect size (f 2) is used to assess a change in the R2 when a particular factor is removed from the model. The cutoff values of effect size are: 0.02 small effect, 0.15 medium effect, and 0.35 large effect (Cohen, 1988; Henseler et al., 2009). The results for f 2 are shown in Table 5.

Table 5. Results of the f^2 effect sizes

Hypotheses	Relationship	Effect Size (f^2)	Effect Size
H1	SystemQ -> SRL	0.007	No effect
H2	InfoQ -> SRL	0.005	No effect
H3	ServiceQ -> SRL	0.024	Small
H4	Attitude -> SRL	0.080	Small
H5	CourseQ -> SRL	0.040	Small

With reference to Table 5, the effect sizes of H3 were: Service quality -> SRL ($f^2 = 0.024$), H4: Attitude -> SRL ($f^2 = 0.080$), and H5: Course quality -> SRL ($f^2 = 0.040$), all relationships exhibited small effect sizes. However, the effect sizes for H1: (System quality -> SRL), and H2: (Information quality Q -> SRL) had no effect sizes.

In summary, the results for the research model used showed that all factors satisfied the criteria of both the measurement and the structural model, so the proposed model is reliable and demonstrates adequate validity.

DISCUSSION

The Relationship between System Quality and Self-Regulated Learning in MOOC

Contrary to other researchers (e.g. Liaw & Huang, 2013; Zhao, 2016), the result of testing (H1) showed that the influence of system quality on SRL was not supported, indicating that the quality of system features such as ease of use, ease in learning, user expectation of the system, system features, and integration does not influence students' SRL skills.

A possible explanation may be related to students' limited experiences with MOOC, since it is a relatively new field in Malaysia context (Nordin, Norman, & Embi, 2015). Analyses of demographic data indicated that 41.3% of the respondents were new to the MOOC environment compared to other e-learning systems. Its features and the way it is conducted may have seemed quite complicated to novice MOOC students, and as novice users they might have experienced problems in navigating the content, activities, and assessments in MOOC.

It therefore seems that not all MOOC students may have the skills necessary to use all MOOC features and participants may also have had confidence issues in using this new technology. Since students new to MOOC tend have obstacles in management of MOOC resources (Kop, 2011), it is suggested that MOOC lectures should provide university training for students to help them acquire the essential skills they need during the MOOC learning and teaching processes.

The Relationship between Information Quality and Self-Regulated Learning in MOOC

The findings of the study concluded that the hypothesis regarding influence of information quality on SRL (H2) was not supported, and result from testing the hypothesis indicated that more availability and understandability of MOOC information would not increase the level of students' self-regulated learning skills in MOOC. The result of this hypothesis testing was not consistent with some other studies conducted in the e-learning system field (e.g. Liaw & Huang, 2013; Zhao, 2016).

One possible justification for the non-significant result of this hypothesis is that students have had problems dealing with the volume of information delivered to them via MOOC. This information includes course content, resources, materials, learning activities, and assessments. If these large bundles of information were not well designed, students may become overloaded with information and be unsure as to which should be prioritized.

Rai and Chunrao (2016) provide an example describing the amount of homework required for a MOOC course entitled Introduction to Computing with Java course offered on edX by Hong Kong University of Science and Technology. The course included 6 lab exercises, 26 problem sets, a final project, and a final exam. The feedback from students indicated that the collective course content and activities were too much for them and overburdened them as MOOC learners.

Consequently, to increase students' self-regulation toward learning via MOOC, it is important for instructors to provide support in terms of guidance and help in navigating the learning content, activities and assessments (Lee & Lee, 2008). It also is best to deliver highly relevant information to the students and align it with the learning objectives of the course to enhance their ability to organize and regulate their learning processes in MOOC.

The Relationship between Service Quality and Self-Regulated Learning in MOOC

The results of this study showed that the influence of service quality on SRL (H3) is supported. This indicated that MOOC service quality, including quality of both instructor support and institutional support, can affect students' SRL skills and improve their effectiveness in MOOC participation and their ultimate success in MOOC learning. For example, the reliability of the MOOC system with respect to answering students' enquiries, and the ability of MOOC in delivering lectures, materials, and feedback to students within a reasonable timeframe, can enhance the students' SRL skills and improve their learning using a MOOC system.

Since several researchers (e.g. Liaw & Huang, 2013; Zhao, 2016) shared similar findings, it is recommended that instructor and institutional support must be considered as key factors for improving self-regulated learning among MOOC students.

The Relationship between Attitude and Self-Regulated Learning in MOOC

The findings of the study concluded that the influence of attitude on SRL (H4) was significant. In other words, a positive student attitude towards MOOC contributes to an improvement in SRL skills, thereby impacting learning success.

A possible explanation for this finding might be that the positive impression of students toward MOOC activities, such as feeling confidence, enjoyment, and interest in using MOOC, may lead to improvements in their self-regulated learning skills. These skills would include the ability to independently organize and plan the learning process, to set learning goals, and to identify effective ways to learn.

The results from hypothesis (H4) are consistent with studies conducted by Kramarski and Gutman (2006), and Zimmerman and Schunk (2001) who found that student attitudes influence their self-regulated learning in e-learning. Researchers such as Presley and Presley (2009), and Hammoud (2010) indicated that student attitudes contribute significantly to successful e-learning implementation.

The Relationship between Course Quality and Self-Regulated Learning in MOOC

Testing hypothesis H5 showed that the influence of course quality on SRL was significant. This finding provided evidence that aspects of quality content such as design, appropriateness of outputs, and ease of understanding of course materials played important roles in supporting SRL skills in a MOOC learning environment.

The significant relationship between course quality and SRL indicated that success in MOOC depends on high-quality course design, its content, and ease of understanding the learning materials. The finding of this hypothesis is supported by studies such as those by Hassanzadeh et al. (2012); Owens and Price (2010); and Sun, Tasi, Finger, and Chen (2008), who indicated that content quality factor has a direct impact on the success of learning in online environments.

The quality of course content is one of the most crucial elements motivating learners around the world to join and engage in MOOC platforms (Yousef, Chatti, Schroeder, & Wosnitza, 2014). An excellent course design will contribute to make students more independent in organizing and planning their learning process and encouraging them to set learning goals, identify effective ways to learn, and achieve success in MOOC learning. Lin, Lin, and Hung (2015) argue that the perceptions of learners toward the quality and richness of MOOC course content have a significant influence on accepting the knowledge.

It is therefore suggested that MOOC developers and instructors should ensure that MOOC materials are easy to understand, and that only high-quality content is to be presented in high-quality format to establish real opportunities for students to become more responsible learners via MOOC.

CONCLUSION

Several studies have highlighted the vital role of self-regulation skills in MOOC (Hood et al., 2015; Kizilcec et al., 2016; Littlejohn et al., 2016; Onah & Sinclair, 2017). Since learners with a higher degree of self-regulated learning are more likely to succeed, developing self-regulated learning abilities in MOOC is a key factor in achieving successful learning in a MOOC environment. While online courses have been found to be favorably regarded by students who have acquired self-regulated learning skills (You & Kang, 2014), research studies related to supporting students to enhance their self-regulated learning skills while learning in a MOOC environment are quite limited. This study, therefore, contributed to closing the gap in the current literature by examining six main factors that influence students' self-regulated learning skills in MOOC environments, and the findings add insight on how to create a successful MOOC environment to support self-regulated learning.

Based on the study's results, the empirical findings indicate that improvement of service quality, attitude, and course quality is very important for promoting self-regulated learning in MOOC environments. In other words, creating self-regulated MOOC environments should build effective interactive learning environments in which these three factors would be carefully considered.

The results of this study are supported by several MOOC study findings that showed the effectiveness of SRL on MOOC (Magen-Nagar & Cohen, 2016). For instance, the result of study by Littlejohn et al. (2016) found that MOOC learners who reported high-level of SRL skills were apt to have more flexibility in their approach to learning and determined their learning paths by themselves.

In sum, this study has investigated the influence of five factors – system quality, information quality, service quality, student attitude and course quality – on students' self-regulated learning skills in a MOOC environment. Thus, this paper extends existing research on SRL to a newer form of learning – MOOC. Future study is hoped to explore the influence of other factors especially psychological aspect on students' SRL in MOOC. It is also suggested that future study to expand the scope of such research into cross-country and culture comparison to better understand how best to support learning in a MOOC environment.

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