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# Explore Factors and Moderators Affecting E-learning System Success

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***Abstract:***
*We incorporate perceived information quality, interactivity of system, task complexity and perceived utilitarian value to IS success model of DeLone and McLean (1992). We are able to capture the impacts of these variables and explain their effects on e-learning system success. Task complexity is used as a moderating variable on how system interactivity and information quality affect perceived learning utilitarian value. Our study shows that system interactivity and information quality positively affect perceived learning utilitarian value, and perceived learning utilitarian value impacts actual learning performance. Task complexity has moderating effects on e-learning system success.*

***Keywords:*** *System interactivity, information quality, perceived learning utilitarian value, and task complexity*

## 1. Introduction

Simply, e-learning system is an information system for learning and teaching. Globally learning and training through e-learning systems will become more important and more popular in the coming decades. E-learning offers all kinds of students the convenience of choosing their preferred time, location and method to study, whether they are high school students, college students or corporate employees. But there are some important issues yet to be explored about the effectiveness and usefulness of e-learning systems.

There are many approaches to assess online learning system. Some researchers developed the e-learning usability model or usability methods (Chiu, Hsu, Sun, Lin, & Sun,2005; Oztekin, 2013). Some previous studies evaluate the users' satisfaction, participant interaction, intention to use, and perceived usefulness of e-learning system (Guo, Xiao, Toorn, Lai, & Seo, 2016; Ho, Ke, & Liu, 2015). Wan, Wang and Haggerty (2008) examine the users' acceptance by exploring the psychological processes. No researchers have tested the moderating impacts of task complexity on the e-learning system success. We think it is important to test the impacts of this moderating variables. It often makes sense to know how online students may respond if they have to face complex task in the online course work.

Our research incorporates such constructs as perceived information quality, interactivity of system, task complexity and perceived utilitarian value to the IS success model of DeLone and McLean (1992). The main goal of our study (Figure 2) is to explore the predictors of e-learning system success, and then investigate moderating factors influencing the e-learning system. We collected the data on the e-learning system success factors such as system interactivity, information quality, and perceived utilitarian value. The rest of the paper consists of a few sections: literature review, research model, research methodology, model testing and results, and discussion and conclusion.

## 2. Literature Review

### *2.1. IS Success Model*

In the IS success model (Figure1) by DeLone and McLean (1992), system and information quality influences perceived usefulness. According to the previous researches, system interactivity and perceived utilitarian value are critical indicators of a website success. The interactivity of systems ensures accurate and relevant information on a course website, and quick response from faculty. Hence, the perceived usefulness can increase when systems are reciprocal and responsive (Yoo, Kim, & Sanders, 2014; Chiu, Hsu, Lai, & Chang, 2012; Zhang, Lu, Gupta, & Zhao, 2014). The literature on website quality shows a positive relationship between website quality and user behavior. It is validated that a higher degree of website quality and usability is related to a higher degree of perceived acceptance (Zviran, Glezer, & Avni, 2006; Carswell & Venkatesh, 2002; Ghasemaghaei & Hassanein, 2015).

However, previous studies have argued for the significant moderating effects of related factors on the relationships between the constructs of the IS success model (Ghasemaghaei & Hassanein, 2015).

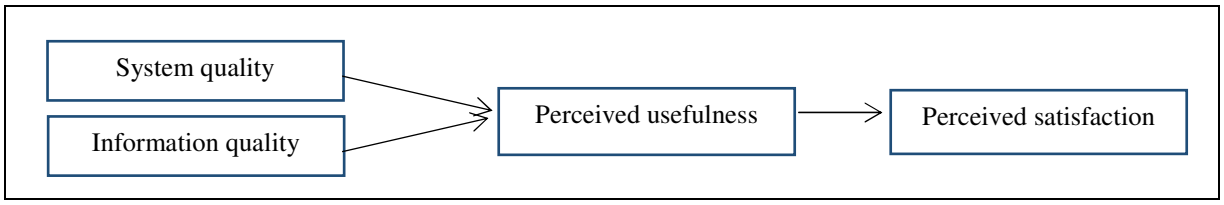


*Figure 1: DeLone & McLean (1992) IS Success Model*

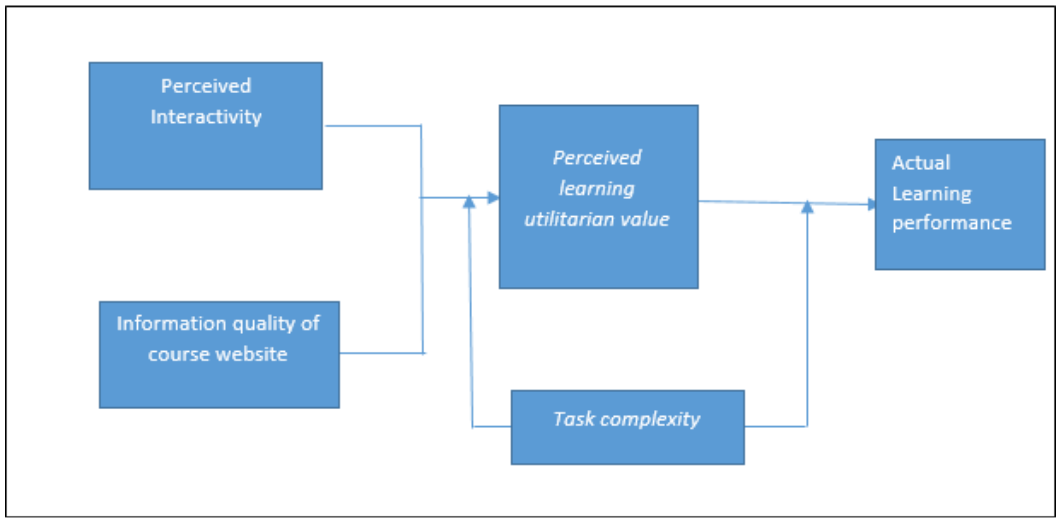


*Figure 2: Research Model: Moderating Effects of Task Complexity on E-Learning System Success*

Task complexity refers to the characteristics of a challenging task that may influence online decision. Task complexity has been found to be a key factor to affect learning outcome. For example, when a task involving multiple distinct elements and diverse information weighs a large amount of perceptive resources, it may impose psychological anxiety on individuals using the e-learning systems, resulting in lower performance (Bystrom & Jarvelin, 1995; Wang, Gray, & Meister, 2014). Therefore, we adopted task complexity to test the moderating effects on the relationship between system and information quality and perceived learning utilitarian value, and the moderating effects on the relationship between perceived utilitarian value and actual learning performance.

The constructs of system quality and information quality were measured to test user perceived usefulness (DeLone & McLean, 1992). Perceived usefulness has been found to increase users' performance and satisfaction. Information quality and system quality are important predictors of perceived usefulness in IS success. The interactivity of systems is one of critical predictors for web decision support systems (Bharati & Chaudhary, 2004)

This paper employs the constructs at the technical level of system interactivity and information quality, and investigates the influence of perceived utilitarian value at the individual level on e-learning system success.

*2.2. E-Learning System*

An e-learning system is defined as an *electronic* system utilizing electronic communication for teaching and learning in distance (Oztekin, Delen, Turkyilmaz, & Zaim, 2013).E-Learning system interactivity focuses on the interaction between individuals and the technologies by posting questions, leaving feedbacks and offering discussions fora better understanding. When online systems are quite interactive, course website information is often more relevant to users' needs. Interactive communications and the faculty's online presence impact website perceived usefulness. The interactivity of the website positively influences perceived usefulness through user involvement by providing and sharing information through quality communications (Yoo, Kim, & Sanders, 2015;Guo, Xiao, Toorn, Lai, & Seo, 2016; Liaw, 2008).

Information quality of e-learning system has been investigated extensively in many prior researches(McKinney, Yoon, & Zahedi, 2002;Ghasemaghaei & Hassanein 2015).The information provided by faculty on a teaching website is one of the important factors to user acceptance on e-learning system (Zhang, Glezer, & Avni, 2014; Xu, Huang, Wang, & Heales, 2014). Further, the learning outcome is defined as the knowledge that the students acquire as a result of the learning process (Xu,Huang, Wang, & Heales, 2014).Actual learning performance is measured in this paper.

## 3. Research Model

*3.1. System Interactivity & Information Quality*

In the DeLone and McLean (1992) Information Systems (IS) success model, information quality is one of the main factors affecting user satisfaction. Guo et al. (2016) defines online information quality as "the usefulness of the available information about an attribute of a product in helping a decision maker evaluate the product". Information quality is a major factor for IS success and has been found

to be an important predictor of satisfaction (Seddon, 1997). Thus, the more instructions students can get from a website, the more perceived utilitarian value they gain in a task (Xu, Huang, Wang, & Heales,2014).

*3.2. Perceived Value Utilitarian and Actual Learning Performance*

In the previous studies, the perceived usefulness of a website helps users fulfill a task. Perceived utilitarian value is equivalent to perceived usefulness when students participate in online courses (Chiu and Wang, 2008). Perceived utilitarian value is defined as positive perceptions of what is received and what is given. Moreover, perceived utilitarian value returns an efficient outcome and can be viewed as reflecting amore task-oriented performance. Researchers have suggested that high level of virtual interacting during discussions enhances the levels of involvement. The prior research also demonstrates that the e-learning systems with high perceived interactivity and information quality provide positive perceived usefulness, thus creating a high level of performance (Liang, Ho, Li, & Turban, 2011; Animesh, Pinsonneault, Yang,& Oh, 2011; and Liaw, 2008).

Hence, we propose:

- → $H_{1a}$. System interactivity positively impacts perceived utilitarian value
- → $H_{1b}$. Online information quality positively impacts perceived utilitarian value
- → $H_{1c}$. Perceived utilitarian value positively impacts theactual learning performance
- → $H_{1d}$. Perceived utilitarian value mediates between System interactivity and actual learning performance
- → $H_{1e}$. Perceived utilitarian value mediates between information quality and actual learning performance

*3.3. Moderating Role of Task Complexity*

Task complexity is defined as difficulty, ambiguity, and lack of clarity involved in the task. Complexity can represent shifting orunstable environments where new information emerges during performance(Campbell, 1988;Lankton,Vance, & Mao, 2010). As noted previously, the task complexity is based on the idea that users perceive less control in the context of the online environment. Researchers indicate low-complexity tasks produce lower perceived information overload. Complex tasks would reduce individuals' ability to pay attention. Task complexity could moderate the effects of perceived usefulness on intentional use (Lankton, Vance, & Mao,2010; Fang, Chan, Brzeinsk, & Xu, 2005). In this research, task complexity is considered as a moderator in the e-learning system success model.

Hence, we propose:

- → $H_{2a}$. Task complexity negatively moderates the relationship between perceived information quality and perceived utilitarian value
- → $H_{2b}$. Task complexity negatively moderates the relationship between perceived system interactivity and perceived utilitarian value
- → $H_{2c}$. Task complexity negatively moderates the relationship between perceived utilitarian values and actual learning performance

## 4. Research Methodology

*4.1. Instrument*

We use the constructs that have been tested in the prior literature. Some modifications were made to reflect the research context. They are listed in Appendix A along with the corresponding literature sources. Perceived system interactivity is measured using 10 items modified from Zhang, Gupta, & Zhao (2014) and Yoo, Kim, & Sanders(2015);perceived information quality from Yoo,Kim, & Sanders(2015);perceived utilitarian value from Guo, Xiao, Toorn, Lai, & Seo(2016); and task complexity from Low & Mohr (2001). Actual learning performance is measured by the real total points students got from the online courses. All the measures were taken on seven-point Likert scales, from 1=strongly disagree to 7= strongly disagree (Appendix A)

*4.2. Data Collection*

The sample of the study consisted of our students in the undergraduate online courses. At the beginning of the academic semesters, permission was obtained from the student subjects to conduct the survey, collect and use their data. The data was collected through an online survey. The survey instrument was placed on the course website during the final week. The students get credits for participating and submitting the survey. 187 students submitted useful survey data for this research.

*4.3. Measurement Model*

Confirmatory factor analysis was used to test the measurement model for the reliability and the validity. We use confirmatory factor analysis to confirm convergent validity and discriminant validity. According to the prior research, the perceptual measures should exceed 0.70(Wallace, Keil, & Rai, 2004).We found the measurement model results with AVE values exceeding the recommended values (Table 1). We also evaluate the discriminant validity using the square root of AVE for each construct, which shows higher than the levels of correlations involving the construct (Table2).

| Constructs | Number of Items | Response Mean | Standard Deviation | AVE | Construct Reliability |
|---|---|---|---|---|---|
| Task Complexity | 4 | 3.11 | 1.08 | 0.63 | 0.74 |
| Perceived Interactivity | 10 | 5.63 | 1.02 | 0.75 | 0.84 |
| Information Quality | 8 | 5.92 | 1.13 | 0.81 | 0.86 |
| Perceived utilitarian value | 2 | 4.72 | 0.92 | 0.66 | 0.71 |

*Table 1: Descriptive Statistics and Convergent Validity Test*

| Construct | Task Complexity | Perceived Interactivity | Information Quality | Perceived Utilitarian Value |
|---|---|---|---|---|
| Task complexity | 0.794 | | | |
| perceived Interactivity | 0.46 | 0.866 | | |
| Information Quality | 0.56 | 0.68 | 0.9 | |
| Perceived Utilitarian Value | 0.53 | 0.58 | 0.57 | 0.812 |

*Table 2: Discriminant Validity*

4.3.1. Model Testing and Results

In formulating and testing the interaction effects using PLS, we need to follow a hierarchical process, in which we compare the results of two models. The effects of the independent variables, mediating variables, and dependent variables are evaluated in the first model. The moderator was added later to evaluate the interaction effects in the second model (Table 3). In this way, the incremental variance explained can be tested out upon moving from one model to the next. The following two models were specified and evaluated to test the hypotheses (Sharma, Durand, & Gur, 1981; Carte & Russel, 2003).

| | Variables |
|---|---|
| Model 1 | Perceived interactivity, information quality, perceived utilitarian value, and actual learning performance |
| Model 2 | Perceived interactivity, information quality, perceived utilitarian value, task complexity, learning performance, interaction term between information quality and task complexity, interaction term between system interactivity and task complexity, interaction term between task complexity and perceived utilitarian value. |

*Table 3: Hierarchical Process*

Thus, $H_{1a}$, $H_{1b}$, $H_{1c}$,$H_{1d}$ and $H_{1e}$can be evaluated in Model 1. Therefore, we first examined the main effect model without including task complexity as a moderator. We found that all paths exhibited a P-value of less than 0.05(Figure 3). Overall, the model accounts for 51.7% of the variance. In addition, the mediating effects of perceived utilitarian value between perceived interactivity and actual learning performance, and those between information quality and actual learning performance, were found to be significant because the relationships between information quality, system interactivity and actual learning performance were reduced when the mediator, the perceived utilitarian value was added to the model. Therefore, we conclude that $H_{1a}$, $H_{1b}$, $H_{1c}$,$H_{1d}$ and $H_{1e\ are}$ all supported based on the results.

Next, the moderating effects can be assessed in Model 2 (Table 3). We examined the interaction effect model including task complexity as a moderator. Overall the model accounts for 58.3% of the variance of actual learning performance (Figure 4). All the paths exhibit a P-value of less than 0.05 except the path between task complexity and information quality. We find no significant relationship between task complexity and information quality.

After analyzing the two different models (Figure 3 and 4), we compared the $R^2$ of both models in order to assess the interaction effects based on the hierarchical difference test, the interaction effects were found to have a size $f^2$ of 0.158 (Table 4). Therefore, task complexity has significantly negative effects on the relationship between perceived interactivity and perceived utilitarian value, and has significantly negative effects on the relationship between perceived utilitarian value and actual learning performance. Therefore, we conclude that $H_{2a}$ and $H_{2c}$ are supported, but $H_{2b}$ is not supported.

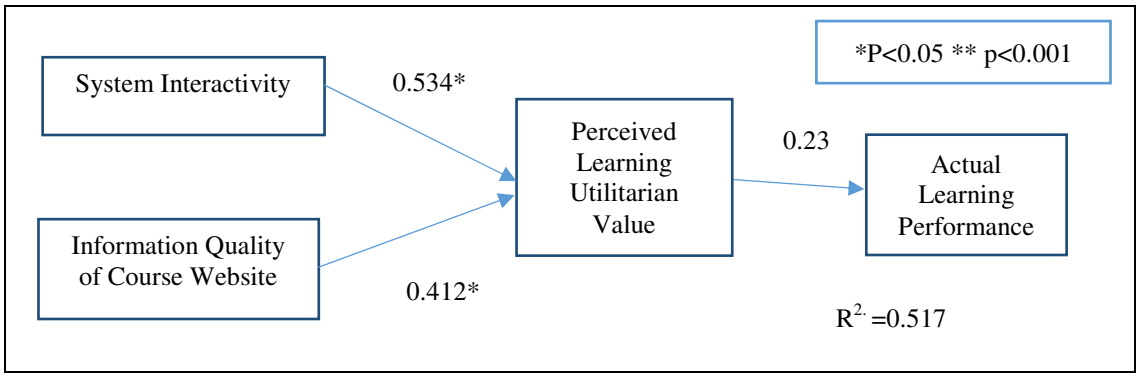


*Figure 3: E-Learning Success Model without Task Complexity*

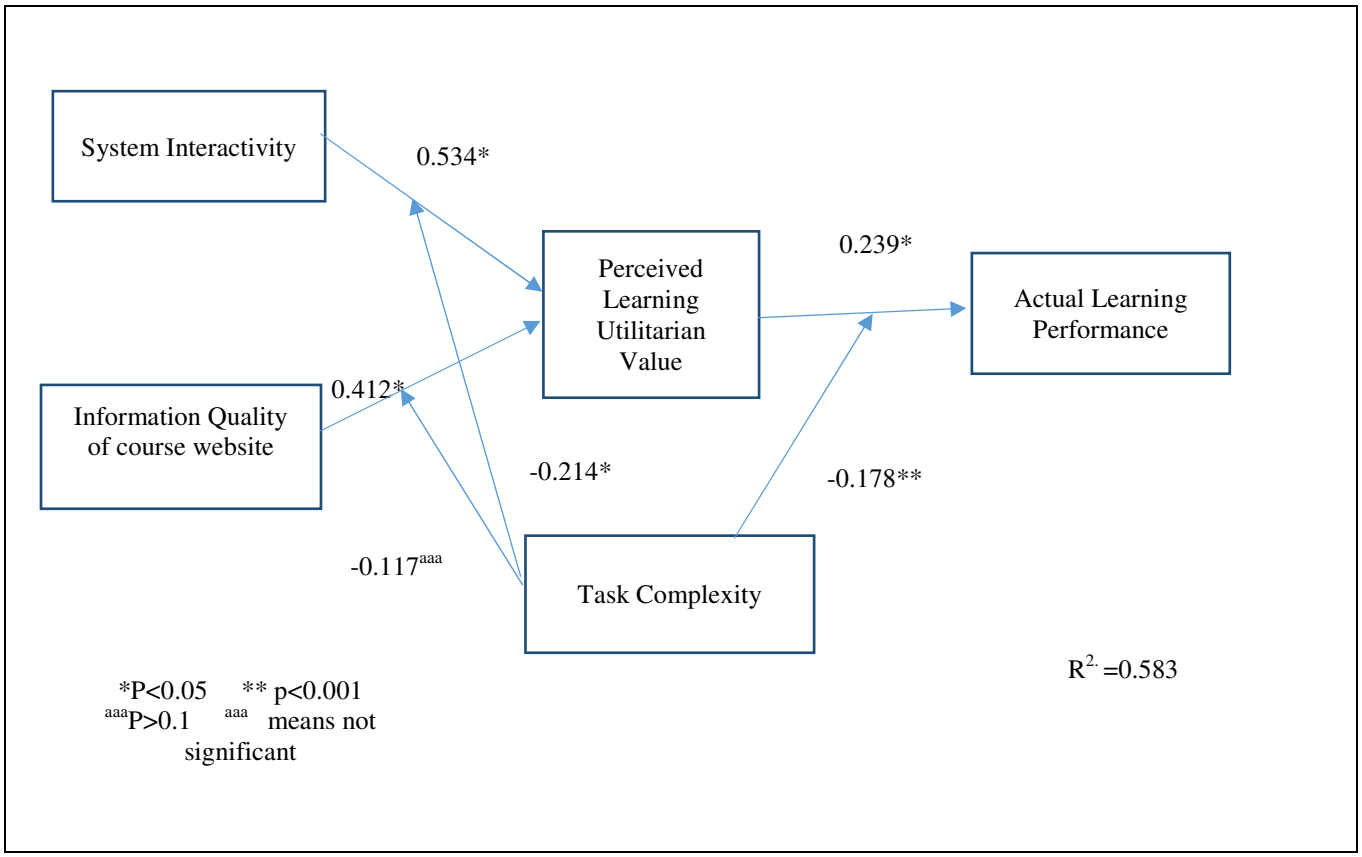


*Figure 4: Moderating Effects of Task Complexity on E-Learning*

| Model | | $R^2$ | $f^{2\,\#\#\#}$ |
|---|---|---|---|
| 1. | E-learning system model | 0.517 | 0.158 |
| 2 | Interaction effect model (with task complexity as a moderator) | 0.583 | |

*Table 4: Effect Size of the Competing Models*

### $f^2 = [R^2$ (Interaction Effect Model) $- R^2$ (Main effect Model)$]/ [1 - R^2$ (Interaction Effect Model)$]$

**5. Discussion and Conclusion**

Our study is designed to gain a better understanding of e-learning system success, and explore moderating effects on e-learning success. Our study shows that perceived interactivity, and information quality positively influence perceived utilitarian value, and then positively impact actual learning performance. This finding is not surprising. There are some suggestions from this finding. First for online course instructors, it is very important to have quality contents available for online students to study. Such quality contents can be from diverse resources as long as copyright laws are followed. Second, it helps if instructors provide a schedule of their online office hours, during which they are ready to answer and communicate with their students. Maybe some other measures can also be considered in order to increase such interactions through e-learning systems. Most e-learning systems come with an online chat and discussion modules. But students are usually more active on popular social media such as facebook.com. According to our finding, instructors may set up such online groups for their online classes through popular social media, which can lead to higher engagement and participation in online courses and better interactivity.

Task complexity negatively moderates the relationship between perceived interactivity and perceived utilitarian value; and task complexity negatively moderates between the relationship of perceived utilitarian value and actual learning performance. However, there is no moderating effects on the relationship between information quality and perceived utilitarian value. The impacts of complex tasks cannot be underestimated. Our finding suggest that quite complex topics probably may not be appropriate for online class, or the teaching effectiveness will not be as expected when online instructors make their classes very difficult for students. This basically means that a very challenging topic may not be appropriate for an online course or online instructors should not make their classes very challenging. So a complete online program may not be in the best interest for both instructors and students unless the contents for the whole program are not very challenging overall.

The findings helped us better understanding e-learning system success, and should benefit e-learning developers and designers and school program coordinators. Although our findings were useful, the study had several limitations. First, we focused on only task characteristics for moderating effects. In fact, as suggested by previous researches regarding e-learning, these factors may interact with individual characteristics to affect learning outcomes. Second, our sample is comprised only of students taking online courses. The results may have been influenced by self-selection bias. Third, using the actual scores to measure learning performance might be objective, but may not be accurate in different online courses with different topics and different instructors. It is possible that different

instructors have different grading policies. Fourth, our online courses are delivered completely through our e-learning systems. We don't use hybrid delivery at the undergraduate level online courses. We are not sure how task complexity can moderate when there is hybrid mode of delivery. With hybrid delivery, students and instructors meet at some scheduled sessions. This way the moderating impacts of task complexity may be quite different than those in pure online delivery.

Our study made several important contributions to e-learning system and online course design. First, we validated predictors of e-learning system, and tested the moderating effects of task complexity on e-learning systems. Then we suggest that e- learning system developers need to consider the system interaction among the interface design of user tasks. From a practical perspective, our study provides an understanding of how system interactivity, task complexity, and information qualitymay affect the development and success of an e-learning system.

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**APPENDIX A**

Perceived utilitarian value (Guo,Xiao, Toorn, & Seo, 2016)

1. In this online course, I accomplished just what I wanted to do for this course.
2. I was disappointed because I had to enroll another course to learn what I wanted to learn from this course. (Reversed)

Interactivity (modified from Zhang, Gupta, & Zhao, 2014; and Yoo, Kim, & Sanders, 2015)

1. allows me to interact with other users by various online communication tools
2. allows me to get feedback from and give feedback to others regarding the quality of messages
3. It is easy to post a question directly on the course website
4. It is easy to see other users' questions and discussions in system
5. The discussion provide appropriate information
6. The discussion through online communication tools provide information that I need
7. The discussion through online communication tools provide relevant information
8. The discussion through online communication tools products are useful
9. The faculty of this online course replies quickly
10. I believe I can get the answer quickly with using course online communication tools

Information quality (modified from Yoo, Kim, & Sanders, 2014)

1. The information regarding the product that the website provides is accurate
2. This website provides information that I need
3. This website provides quite professional information
4. The overall structure of the website is easy to understand
5. I can easily and effectively find the information I need
6. It is easy to go back to the information searched before whenever wanted
7. The provided information from the website has good temporal relationship
8. This website provides the most recent (or updated) information quickly

Task complexity from (Low & Mohr, 2001)

Performing activity is

1. Easy/difficult
2. Clear/ambiguous
3. Straightforward/ill-structured
4. Simple/complicated