The Mediating Effects of Germane Cognitive Load on the Relationship Between Instructional Design and Students' Future Behavioral Intention

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Abstract: Instructional design is an important aspect of the learning experience within formal online courses. One way in which online instructional design may benefit students is by increasing their future behavioral intention to use educational materials. This is important because research has revealed that students' use of educational resources is strongly connected with academic success. Additionally, higher quality instructional design will increase students' levels of germane cognitive load, which is a powerful indicator of learning. This study surveyed a group of students (n = 1314) who participated in formal online classes in South Korea to investigate the relationships between instructional design and germane load, germane load and future behavioral intention, as well as instructional design and future behavioral intention. Results showed positive correlation among each of these relationships. Furthermore, a mediation model was used, and results showed that germane load completely mediates the relationship between instructional design and future behavioral intention. These relationships are examined to better understand learning and future behavioral intention in relation to instructional design within online learning environments.

Keywords: behavioral intention, cognitive load, germane load, e-learning, instructional design, MOOC

1. Introduction

Massive Open Online Courses (MOOCs) often serve as a replacement for traditional face-to-face university courses through the use of e-learning environments that substitute for offline university classrooms (Lee & Lee 2015; Yuan & Powell 2013). MOOC-like courses have gained recent popularity around the world, as university students are seeking alternative means of learning in higher education (Yuan & Powell 2013). South Korea in particular has experienced an increase in such online learning enrollment due to advancements in technology and more government funding, which has led to more high-quality online offerings (Kim & Santiago 2005; Korea Internet & Security Agency 2015; Korean Ministry of Education, Science & Technology 2010; Lim 2014). MOOCs have been found to be diverse in regards to user location around the world, professional background, age, and gender (De Waard, Abajian, Gallagher, Hogue, Keskin, Koutropoulos & Rodriguez 2011). Reasons for participation in MOOCs include schedule flexibility, the convenience of studying anytime and anywhere, the desire to access courses that may not otherwise be available, the possibility of professional advancement and future economic benefits, topic curiosity, as well as simple enjoyment (NCES 2008; Traphagan, Kucsera & Kishi 2010; Yuan & Powell 2013).

In addition to examining reasons why students participate in MOOCs, it is useful to understand the reasons why students decide to continue using MOOCs in the future. This is particularly important, as participation issues are apparent in MOOCs, as students who use them are not always successful in staying motivated and often fail to effectively engage in the content (Yuan & Powell 2013). Potential influences of students' intentions to continue using MOOCs include the reputation of the MOOC, perceived openness, perceived usefulness, and student satisfaction (Alraimi, Zo & Ciganek 2015). It is also important, however, to look at instructional design decisions that may influence MOOC users' decisions to continue. Effective instructional design is important in online learning situations because of the need to compensate for the physical absence of an instructor. This is so that students are able to maintain focus and process information in ways that support high levels of understanding that may be lacking in online situations (Al-Qahtani & Higgins 2013; Cole, Shelley & Swartz 2014; Jung 2000; Lee & Rha 2009). Investigating aspects of instructional design along with germane cognitive load is useful in this area, as germane load is reflective of how well students understand content delivered through instructional design (De Jong 2010). Furthermore, increasing germane load through effective instructional design may help to discover ways of promoting further usage of e-learning in the future (Liu, Chen, Sun, Wible & Kuo 2010).

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Past research has looked into ways in which specific types of instructional design are beneficial to both germane load as well as students' intention to continue using e-learning. It is generally accepted among researchers that effective use of instructional design should result in higher levels of germane load (Cierniak, Scheiter & Gerjets 2009; Sweller, Van Merriënboer & Paas 1998). Learning, which has been seen as a direct result of higher levels of germane load, has been positively linked to instructional design that focuses on instructor control of the learning environment (Costley & Lange 2016). Additionally, instruction focusing on design and organization used for setting the overall plan of the course has been found to promote perceived learning among online students (Shea, Fredericksen, Pickett & Pelz 2003). Positive relationships between instructional design and intention to use e-learning have also been found. Such research has conceptualized instructional design as a way of providing individual learning support (Liu, Liao & Pratt 2009), as well as promoting interaction between students (Cheng, Wang, Yang & Peng 2011). Acknowledging that effective use of instructional design is beneficial to both germane load and intention to use, it would be useful to examine the relationship between germane load and intention to use to see if students who have a good understanding of the content also plan on continuing with e-learning in the future.

Although research has looked at instructional design that leads to higher levels of learning and continued usage, some aspects of instructional design focusing on the overall planning of the course have yet to be examined as a way to promote future behavioral intention based on a better learning experience. Such instructional design factors are promoted by Anderson, Rourke, Garrison & Archer (2001), which include setting the curriculum, designing methods, establishing time parameters, establishing group norms (netiquette), and utilizing the medium effectively. The current study surveyed a group of students in South Korea (n = 1314) participating in the Open Cyber University to see if students who received instruction reflective of Anderson et al.'s (2001) instructional design model, also showed higher levels of germane load and intention to use. It may be the case that Anderson et al.'s (2001) instructional design model contributes to the student learning experience and also students' decisions to continue with e-learning in the future based on that experience. With that being said, the current study looks at relationships between the following: instructional design and germane load, germane load and future behavioral intention, instructional design and future behavioral intention. Furthermore, because it is thought that the actual reason why students plan on continuing with the e-learning process is due to high levels of understanding gained from the instructional design, it is hypothesized that there will be a mediating effect of germane load on the relationship between instructional design and future behavioral intentions. It is worth investigating whether instructional design that focuses on setting the plan for the course leads to an increase in germane load, further enhancing the learning process and possibly contributing to students' future behavioral intentions. Based on these ideas, the following hypotheses are proposed:

H1. Levels of instructional design are positively correlated with future behavioral intentions.
H2. Levels of instructional design are positively correlated with germane load.
H3. Levels of germane load are positively correlated with levels of future behavioral intentions.
H4. The effect of instructional design on future behavioral intentions is mediated by germane load.

2. Theoretical Background

2.1 Instructional Design

Within the Community of Inquiry's conceptualization of teaching presence, instructional design and organization is made up of five parts: setting the curriculum, designing methods, establishing time parameters, establishing group norms (netiquette), and utilizing the medium effectively (Anderson et al. 2001). Because online classes may lack some of the norms established in face-to-face classrooms, instructors need to be more explicit and transparent in their planning process (Anderson et al. 2001). Anderson et al. (2001) emphasize the importance of this design process, stating that the five aspects of design should all be applied to give students a clear idea of the overall plan of the course in order to maintain focus and direction. Shea et al. (2003) provide a descriptive account of what instructors specifically need to address within each of Anderson et al.'s (2001) categories so that students can fully comprehend the design of the course and take advantage of the design in order to succeed. Setting the curriculum should include the distribution of documents specifically indicating important course goals and outcomes. Learning activities and assignments are important in online learning, but explanations of how to participate in and complete them is needed through instructor explanation of how to participate in the learning activities. Clear instructions of how to complete certain tasks can give students a better idea of how to succeed in the course. Furthermore, students need to be aware of specific dates that

assignments and activities should be completed by. This is done by establishing time parameters to help students keep pace with the course. Utilizing the medium effectively focuses on helping students to make sure they have no problems using the technology required for completion of the course. Shea et al. (2003) describe this as helping the students take advantage of the online environment. Finally, establishing group norms refers to an adherence to what Anderson et al. (2001) call "netiquette". Instructors need to help students in this area to ensure that they are adhering to acceptable behavioral norms within the online environment, including communicating in a respectful way online.

2.2 Germane Load

Instructional design is often linked to aspects of cognitive load theory, which explains the existence of three elements related to the learning process: intrinsic load, extraneous load, and germane load (Sweller et al., 1998). Intrinsic load represents the complexity of the learning content in addition to the prior knowledge of the content that the individual processing the content has (Sweller & Chandler 1994). Extraneous cognitive load occurs through poor instructional design that causes unnecessary processing within the working memory, leading to a negative effect on germane load, and ultimately the learning experience (Cierniak et al., 2009; Leppink, Paas, Van der Vleuten, Van Gog & Van Merriënboer 2013; Schmeck, Opfermann, van Gog, Paas & Leutner 2015). Unlike intrinsic load and extraneous load, higher levels of germane load are viewed as more useful to the learning process (Cierniak et al. 2009). Specifically, germane load represents how well students understand the contents, which directly contributes to learning. Furthermore, some research claims that germane load reflects the effort to construct schema to gain a better understanding of the processed information (Kolfschoten, Lukosch, Verbraeck, Valentin & Vreede 2010; Sweller et al. 1998). In the context of germane load, schemas are generally constructed through processes including interpreting, exemplifying, classifying, inferring, differentiating, and organizing information (De Jong 2010). Because germane load is reflective of student effort to construct schema, it is generally linked to student interest and motivation that go into forming such schema (Shadiev, Hwang, Huang & Liu 2015). Although forming schema has been associated with germane load, a contrasting explanation is that germane load does not actually deal with schema formation, but rather a formation of a set of learning strategies employed by the students (Schnotz & Kürschner 2007: Galy, Cariou & Mélan 2012). Regardless of whether germane load is linked to the formation of schema or the formation of learning strategies, the generally accepted position is that germane load represents how well the students understand content delivered to them (Ayres 2006). Leppink et al. (2013) reflect this notion through their construct that associates germane load with the understanding of specific types of instruction delivered to students. A goal of high quality instructional design is to promote high levels of germane load, ultimately creating a more positive learning experience (De Jong 2010).

2.3 Behavioral Intention

The theoretical framework of behavioral intention can be found in the theory of reasoned action, which describes what goes into the process leading to a course of action by an individual (Ajzen & Fishbein 1980). According to this theory, behavioral intention involves a cognitive decision to commit to a behavior, and that the decision regarding the behavior is a direct result of the intention itself. Additionally, the decision to commit to the behavior or not is influenced by what the individual perceives as the consequences of the behavior. Attitudes and subjective norms contribute to the decision of intention, where attitudes represent how positive or negative the individual feels about the behavior and subjective norms represent the social pressure one feels in committing to a specific behavior. Ultimately, based on the cognitive processes involved in making the decision to commit, behavioral intention is a representation of what an individual plans to do, based on those processes that lead to the decision. Additionally Ajzen (1991) describes that beyond attitudes and social norms, a person's perceived ability to successfully complete a specific act plays a role in deciding on the intention. Known as perceived behavioral control, it highlights the importance of understanding something in order to commit to it. Students' future behavioral intention to participate in e-learning has been seen as an important attribute for success within online learning environments (Giannakos, Jaccheri & Krogstie 2015). Instructors should be mindful of students' intention to use e-learning, as it allows instructors to design useful online environments that promote continued usage of them in the future (Grandon, Alshare & Kwun 2005; Lee, Yoon & Lee 2009). E-learning environments should, therefore, be designed in a way in which students believe the design of such environments is contributing to their learning process. Research supports this, as students who have considered the e-learning environment helpful, have also indicated that they wish to continue to use such environments in the future (Liaw 2008). The notion of *intention to use* comes from Davis, Bagozzi, and Warshaw's (1989) technology acceptance model, which promotes perceived usefulness and perceived ease of use of technology to determine intention to use the technology again in the future.

Perceived usefulness represents the students' perceptions of how much the technology being used will aid in his or her performance. Perceived ease of use represents the degree to which students feel the technology will minimize effort.

2.4 Effects of Instructional Design on Behavioral Intention

Acknowledging that perceived usefulness and perceived ease of use of e-learning are predictors of intention to use, it is important to design instruction that leads to such perceptions among e-learning users (Davis et al. 1989). This sentiment is echoed by researchers who claim a need for design strategies that promote factors contributing to future behavioral intentions (Lee 2010; Wiggins 1998). Although it makes sense to promote future behavioral intentions through specific instructional design methods, there is limited empirical evidence supporting this notion. Liu et al. (2009) investigated future behavioral intention levels of students who received online course design aimed at promoting interaction with peers and instructors. The findings showed that course design significantly affected future behavioral intentions through increased levels of perceived usefulness and perceived ease of use. The results are useful for student-centered instructional design with a focus on interaction, as student perceptions of such design led to higher levels of future behavioral intentions. Cheng et al. (2011) looked at how instructional design affects future behavioral intentions among students using an e-learning system, with an emphasis on perceived individual learning support as part of the instructional design. Within this context, instructional design has been shown to be effective with regards to user acceptance of e-learning systems, as the results showed that the use of such instructional design was positively related to the students' future behavioral intentions. The limited amount of research has shown positive effects of instructional design on future behavioral intentions, but more research is needed to compare yet-to-be examined design techniques that may also affect student future behavioral intentions. Specifically, examination of learning support and the role it plays in future behavioral intentions can be extended to include the ways in which Anderson et al.'s (2001) model support student learning through effective planning of the course. Furthermore, some in class design elements like the use of more diverse media has been shown to have a positive effect on student's future behavioral intention (Costley & Lange, 2017).

2.5 Effects of Instructional Design on Germane Load

Proper use of instructional design leads to higher levels of germane load (Cierniak et al. 2009; Sweller et al. 1998). Ways of promoting germane load may not only be through the presentation style of the materials but also through clear instructions of how to successfully complete tasks related to the material (Huang, Liu & Tsai 2013). Instructors need to also provide clear instruction in a way that avoids explanations that are either redundant or irrelevant to the learning process (Chandler & Sweller 1991). Furthermore it has been shown that more tightly controlled instructional design elements lead to greater levels of student learning and satisfaction (Costley & Lange 2016). Based on previous research, it is apparent that instructors need to present material in a way that captures attention, as well as design instruction with clear explanations of how to successfully complete tasks. Employing these types of instructional design techniques has been shown to be beneficial to increasing levels of germane load. In the case of online learning communities it has been shown that when instructors efficiently and effectively facilitate the online learning experience students perceive higher levels of learning (Akyol & Garrison 2008). Shea et al. (2003) showed that a variety of instructional behaviors, including design and organization also led to higher levels of student learning in an online learning environment. Such design and organization examined by Shea et al. (2013) includes Anderson et al.'s (2001) instructional design model that focuses on setting the overall plan of the course.

2.6 Effects of Germane Load on Behavioral Intention

Limited research has been found that specifically connects germane load to future behavioral intentions. Relationships between germane load and future behavioral intentions can be inferred through the examination of perceived ease of use, and the role it plays on future behavioral intentions. Germane load has been shown to be a result of imposing less cognitive strain on the students (Cierniak et al. 2009; Leppink et al. 3013; Schmeck et al. 2015). Because of this, it is reasonable to assume that students, who experience less cognitive strain within their working memory, also perceive higher levels of ease of use because less effort is needed to gain an understanding of concepts presented in an e-learning environment. Therefore, it is reasonable to conclude that high levels of germane load, created by ease of use, contribute to future behavioral intentions.

Although there is a lack of supported evidence to tie germane load to higher levels of future behavioral intention to use MOOC-like courses, research does exist that indirectly connects cognitive load to intention to use mobile devices to complete specific tasks (Coursaris, Hassanein, Head & Bontis 2012). Based on research that shows visual and auditory distractions lead to higher levels of extraneous cognitive load, Coursaris et al. (2012) examined the effect of increased cognitive load imposed on mobile phone users while performing specific tasks with their devices. The increase of cognitive load was represented by various visual and auditory environmental distractions. The results showed that users who experienced an increase in cognitive load due to auditory and visual distraction differed from the group that did not receive such distractions with regards to their levels of perceived efficiency of the mobile device. Additionally, higher levels of efficiency were related to higher levels of satisfaction. Finally, those users that were satisfied with the experience also showed higher levels of future behavioral intention. Overall, the results concluded that an increase in cognitive load caused by environmental distractions had a negative effect on perceived efficiency, which in turn, also had a negative effect on user satisfaction and ultimately intention to use mobile devices. Although Coursaris et al. (2012) did not investigate germane load levels as they relate to future behavioral intention, it does show an indirect relationship between cognitive load and future behavioral intentions.

2.7 How Germane Load Mediates the Relationship between Instructional Design and Behavioral Intention

Limited research was found that showed an effect of instructional design on future behavioral intention through mediation of germane load. Liu et al. (2010) has found important relationships between the three variables that show how they are interconnected. In their study, the development of a user-interface within an online learning community was examined as part of effective instructional design. The results showed designing a user-interface that focuses on the reduction of cognitive load leads to high levels of behavioral intentions to use online community learning in the future. Although no mediation was found, the results of their study did show that when designing the user interface, steps should be taken to reduce cognitive load, which should result in higher levels of future behavioral intention. Research has also shown that perceived usefulness of the technology mediates the effect of perceived ease of use on intention to use (Lee et al. 2009; Venkatesh & Davis 2000). Based on previous research, if such design is effective in reducing levels of extraneous cognitive load, higher levels of germane cognitive load will be evident as a result, and possibly promote student intention to use e-learning again in future learning situations. The current study attempts to take findings like these a step further and connects higher levels of germane load to future behavioral intention. Furthermore, rather than looking at effective use of user-interface as part of instructional design, the current study focuses on more detailed instructional design decisions used to clearly communicate to students ways in which they can succeed.

3. Methods

3.1 Contextual background

The participants in this study took Open Cyber University of Korea (OCU) classes in the first semester of 2016. While the OCU was founded in 1997, it was not until 1998 that classes were opened for students to attend (Jung & Rha 2001). A network of traditional face-to-face universities fund the OCU, enabling their students to take advantage of the variety of classes provided by the OCU. Further to this, the OCU also offers degrees to fully online students (Jung 2000). According to the OCU, they provide the largest form of MOOC-like courses in South Korea with 23 brick-and-mortar universities, 400 courses, which serve approximately 120,000 students every year (About OCU n.d.). The students involved in this study were attending face-to-face classes at their traditional university while also attending classes at the OCU.

The universities, which form part of the OCU, provide both the content and design of the courses (Jung & Rha 2001). There is generally little student-to-student interaction in OCU classes, though some classes offer offline meetings while others have offline assessment. To manage the OCU, a council of representatives from the member universities creates policy and deal with day-to-day operations (Jung & Rha 2001). Furthermore, a team of programmers, instructional design professionals, and an evaluation team help create, maintain, and improve the learning environments used at the OCU. According to the OCU homepage, the OCU was selected as the best open online consortium OCU in Korea based on 21 evaluation indicators, including student's willingness to learn, student loyalty, faculty professionalism, and appropriateness of professional personnel (About OCU n.d.).

As will be mentioned in more detail in paragraph 3.3, 10 students from a national university in South Korea were interviewed about their views and involvement in the OCU. After these interviews and a preliminary survey, a final survey was compiled. This survey was in a Google Sheets form and was posted on the main administration board of the OCU in April 2016. Before the survey was posted, the administration of the OCU checked that the survey met their ethical requirements and that it was acceptable for students to participate in the research. Students' were asked to respond to the items in the survey, based on how they experience the class they were taking that semester. Students who took more than one class were only allowed to respond to the survey once. A total of 1475 out of approximately 60 000 students completed the anonymous survey at the beginning of May 2016, immediately following midterm assessment. However 161 surveys were incomplete for the purposes of this study and were therefore removed from the analysis, leaving 1314 responses to be used in this analysis. Of the 1314 participants, 679 (52%) were females and 635 (48%) were males. The oldest participant was 63 and the youngest was 19, with an average subject age of 23.5. The students who participated in this study took a wide variety of classes at the OCU.

3.2 Models

The hypotheses examined in this research can be shown using the path diagrams found in Figures 1a and 1b. Figure 1a illustrates the total effect of instructional design on students' future behavioral intention from the OCU. In keeping with Hypothesis 1, this figure suggests that high levels of instructional design are positively associated with future behavioral intentions. However, this research proposes that the relationship between instructional design and students' future behavioral intentions can be better understood through the inclusion of a third mediating variable, germane load. Through the inclusion of this mediating variable, we are able to obtain a more nuanced understanding of how instructional design affects future behavioral intentions by disaggregating the total effect (Path c) into two distinct effects-direct effects (Path c) and indirect effects (Paths a and b). These effects are illustrated in Figure 1b. First, as Figure 1b shows, at least a degree of instructional design's effects on future behavioral intentions will occur indirectly-first, higher levels of instructional design will increase levels of germane load (Path a), and, in turn, higher levels of germane load will increase students' future behavioral intentions (Path b). This indirect relationship is addressed by Hypotheses 2 and 3. The balance of instructional design's total effect upon future behavioral intentions is likely to occur via a direct relationship between these two variables as shown by Path c' in Figure 1b.

To better understand the relationships discussed in the previous paragraph, this research makes use of Baron and Kenny's (1986) three equation method for modeling mediation. This study also follows the process used in Porumbescu (2017).

Step 1: The dependent variable should be regressed on to the independent variable to ascertain if the independent variable is a statistically significant predictor of the dependent variable. Independent variable → dependent variable.

$Y = \beta_{10} + \beta_{11}X + \varepsilon_2$

β_{11} is significant.

Step 2: The mediating variable should be regressed on to the independent variable to check that the independent variable is a statistically significant predictor of the mediating variable. If there is no relationship at this stage, then clearly the mediator does not mediate anything. Independent variable → mediating variable

$Me = \beta_{20} + \beta_{21}X + \varepsilon_2$

β_{21} is significant

Step 3: The dependent variable should be regressed on to the mediating variable and the independent variable to check that the mediating variable is a statistically significant predictor of the dependent variable, and the relationship between the independent variable and dependent variable from step one, is significantly reduced or absent.

$Y = \beta_{30} + \beta_{31}X + \beta_{32}Me + \varepsilon_3$

β_{32} is significant

β_{31} Should be smaller than the original relationship between the independent and dependent variables (β_{11}) Another way of looking at this would be to consider that there are four criteria that must be met for mediation to have occurred: (a) there must be a statistically significant relationship between the independent and dependent variable without the mediator, (b) the independent variable must have a statistically significant relationship with the mediator, (c) the mediator must have a statistically significant relationship with the dependent variable, and (d) the relationship between the independent and the dependent variable decreases or disappears when controlling for the mediator.

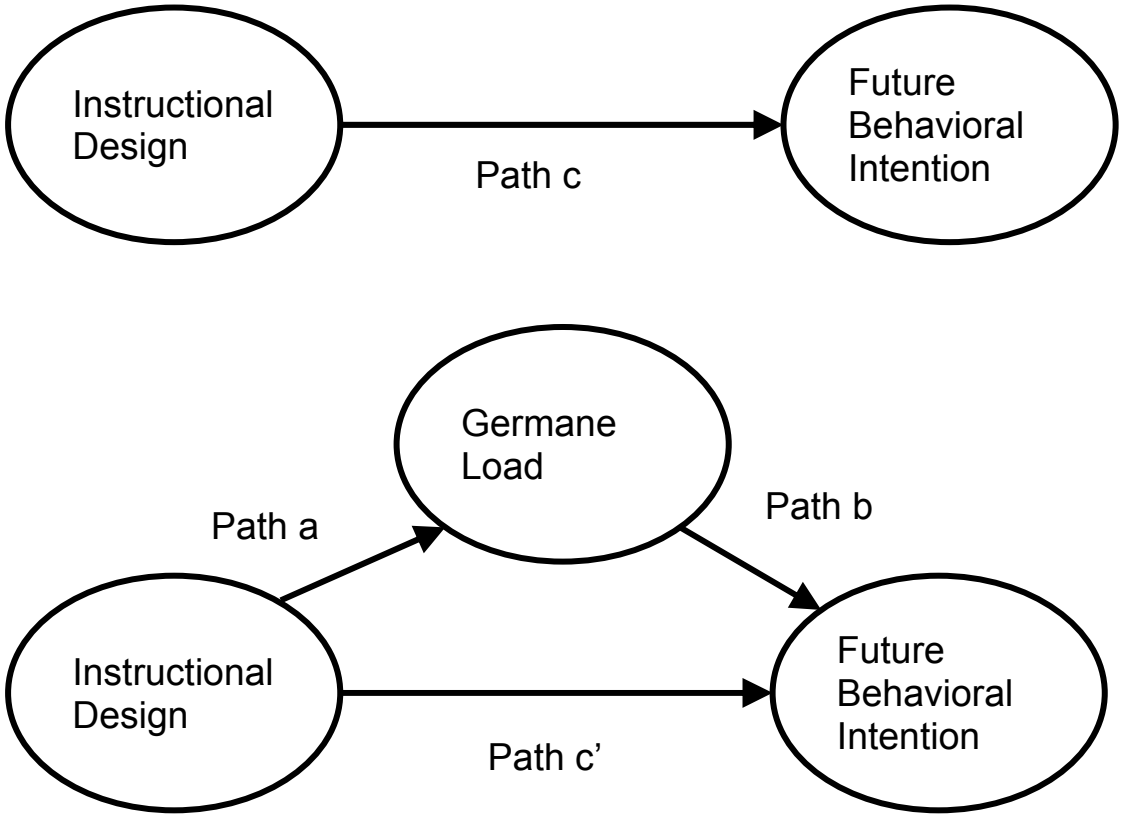

Figure 1. Path Diagram of Relationships

3.3 Instrument development

Korean cyber universities and the OCU specifically lack a great deal of research into their learning environments. For this reason a series of interviews were designed and administered before creating the instruments used in this research. Instrument development began with a series of short qualitative interviews with 10 students who had been part of the OCU. The initial purpose of this questioning was to discover the nature of student-to-student interaction and how that was affected by the learning materials that were part of the OCU, particularly the lectures. However, none of the interviewees had any online interaction with other students, so we decided a broader set of research questions would be more appropriate. In relation to studying on the OCU, Kim's response was typical, "I just watched the videos and did the exams, there were other things but I didn't do them." This type of opinion, and the fact that all interview participants said that there was little instruction or activities outside the video lectures in the OCU meant that it was decided that research would focus on general aspects of instructional design and the quality and variety of the video lectures.

Once the interviews were finished, 92 students were given a broad survey about the OCU to complete. The survey covered issues such as the amount of cheating in the OCU, instructional design, automated feedback systems and video lectures. The results of the survey raised several important issues regarding instruction and

student perceptions of the instruction on the OCU. For that reason, a second study was prepared. That study would be larger in that more students would be involved. Also, it would be more specific and focus on the instruction in the OCU and the students perceptions of that instruction. It is the results of the second larger study that will be used in this paper. These questions included items about instructional design, germane load, future behavioral intentions, the quality of lectures, and the OCU's automated feedback system. These issues were focused on as the students interviewed mentioned these as the most salient features of the OCU's learning environment as well as the interviewees' responses. Within the Korean online learning context, direct instruction is a key feature of the education experience (Han, 2012). This is likely because of cultural norms, in which there is an expectation that students are simply the receivers of knowledge doled out to them from instructors (Lim, Kang & Park, 2016).

The survey contained 12 items that directly relate to this study. Five were used to generate the instructional design construct, four were used to generate the germane load construct, and three were used to generate the future behavioral intentions construct. The initial survey was given to 10 potential respondents, and, after completing the survey, the respondents gave feedback on the appropriateness of the items. In response to this feedback, the items remained largely the same, though there were some slight changes to make the items more appropriate when translated into Korean.

There were five items used to generate the level of instructional design used in this paper's instrument. The items were measured using a likert-type scale ranging from 0 to 10, with 0 being strongly disagree and 10 being strongly agree. They were developed by Shea et al. (2003) and based on the instructional design and organization part of teaching presence from Anderson et al. (2001). In Anderson et al., five different indicators are used: *establishing netiquette, establishing time parameters*, *setting the curriculum*, *designing methods*, and *utilizing the medium effectively*. Shea et al. (2003) designed the items to be reflective of the online instructional design indicators provided by Anderson et al. (2001). The students responded to these items based on the instructional design aspects they faced within their classes in the OCU. The five items were presented as follows: *Overall, the instructor for this course clearly communicated important course outcomes (for example, provided documentation on course goals). Overall, the professor for this course clearly communicated important course topics (for example, provided a clear and accurate course overview) Overall, the instructor for this course clearly communicated important due dates/time frames for learning activities that helped me keep pace with the course (for example, provided a clear and accurate course schedule, due dates, etc.). Overall, the instructor for this course helped me take advantage of the online environment to assist my learning (for example, provided instructions on how to navigate or use the online system). Overall, the instructor for this course helped students to understand and practice the kinds of behaviors acceptable in online learning environments (for example, how to communicate with the professor or students online).* Cronbach's Alpha for the five items was calculated to be .909, which was deemed high enough to be used as a single construct representing instructional design.

To create the germane load scale, four items were used and measured using a likert-type scale ranging from 0 to 10, with 0 being strongly disagree and 10 being strongly agree. The items came from Leppink et al.'s (2013) paper on *The development of an instrument for measuring cognitive load*. In Leppink et al.'s (2013) paper, the three main types of cognitive load - intrinsic, extraneous and germane - are discussed. In their research, exploratory factor analysis was used and the four items representing germane load were found to be an actual representation of how instruction and explanation contribute to learning. The fact that the loadings for germane load represented a robust factor, separate from intrinsic load and extraneous load, supports the triarchic theory of cognitive load, which according to DeLeeuw and Mayer (2008) allow for different aspects of cognitive load to measured separately. Because germane load was found to represent the contribution of instruction and explanation to learning, regardless of the intrinsic and extraneous load factors, the current study used the germane load construct as an independent measure of how instruction and explanation contribute to learning. Additionally, justification for use of the germane load construct in an online setting is provided by Debue and Van De Leemput (2014), who adapted Leppink et al.'s (2013) items to determine if various ways of using hypermedia within an online context would have an effect on cognitive load. Their germane load items were found to have an appropriate level of internal consistency to use as a single construct. Furthermore, through factor analysis, the germane load factor was shown to be a sufficient representation of the items, which were modified to reflect the online context. The current paper uses Leppink et al.'s (2013) items to measure germane load with slight modification to focus on the lecture sections of the OCU classes. This was done in accordance to Leppink et al.'s (2013) claim that rewording text to match the

context of a specific study is an acceptable modification to the items. The items used in the current study are as follows: *The lecture really enhanced my understanding of the topic, the lecture really enhanced my knowledge and understanding of the of the class subject, the lecture really enhanced my understanding of the concepts associated with the class subject, the lecture really enhanced my understanding of concepts and definitions*. To assess internal reliability of the germane load construct, Cronbach's Alpha was found to be .962, similar to .82 found by Leppink et al. (2013), and which is very high and appropriate for research of this type.

For the future behavioral intentions construct, there were three items used. The scale was focused around behavior that the student would do in the future, as related to their intention towards the lectures. The three items were measured using a likert-type scale ranging from 0 to 10, with 0 being strongly disagree and 10 being strongly agree. These items were adapted from Sørebø, Halvari, Gulli & Kristiansen's (2009) paper on user's continuation of use of education technology. Sørebø et al.'s (2009) items were designed to reflect research that focuses on student intentions to continue using e-learning platforms. The items used in this study were slightly altered to represent OCU lectures, which are presented in video format containing various instructional design aspects delivered by the instructors. The three items were: *I intend to continue watching the video lectures, I intend to use the videos as the main source of information throughout the semester, I don't want to watch any more lectures.* Cronbach's Alpha (.905) found with the items of the present study were similar to the .86 Cronbach's Alpha found by Sørebø et al. (2009). This internal reliability was used to justify combining the three items into one construct. These items can be considered to have content validity in that they have been drawn up through investigation of the subject domain as shown by their connection with other research into student's future behavioral research mentioned above. Furthermore, two experts in online learning and student behavior in the OCU reviewed the items before the survey was distributed. According to Foxcroft, Paterson, Le Roux & Herbst (2004), these two factors combined together establish content validity.

4. Results

Descriptive statistics are shown in Table 1. The mean for students' future behavioral intentions was 5.60. This implies that students have a neutral opinion of the classes they took online and the likelihood of those classes to inspire further use of the lectures for study. The mean for instructional design was higher at 6.26. This shows that students have a slightly positive view of the levels of instructional design in the classes that they took. This suggests that students feel they are given an appropriate amount of information about the format and delivery of their classes. Finally, the mean value for germane load was 6.31, which shows a slightly positive view of how the students' felt they learned overall from the classes they took from the OCU.

Table 1: Correlations of the Main Variables

	Minimum-maximum values	M	SD	(1)	(2)	(3)	(4)	(5)
(1) Age	19-63	23.50	3.8	1				
(2) Gender	*NA*	*NA*	*NA*	.181*	1			
(3) Design	0.0 - 10.0	6.26	2.18	-.06	.07*	1		
(4) Germane load	0.0 - 10.0	6.31	2.24	-.05	-.07	.56*	1	
(5) Future behavioral intentions	0.0 - 10.0	5.60	2.76	-.11	.09*	.35*	.62*	1

$p = < .05$

Table 2 shows the results of the three regression equations used in the mediation analysis for this study. All variables shown in the analysis in Table 2 are standardized. In all three equations, the *F* values are statistically significant ($p < .01$), and the adjusted r^2 values range from .15 to .39. These values suggest that the equations used as a part of this research are statistically significant and explain variation in the data as well.

The first model, equation 1, shows that higher levels of instructional design are positively associated with students' future behavioral intentions scores. (Path c: total effect); the mediating variable (germane load) is not present in this regression. This result provides support for the idea that increasing the quality of instructional design will have a positive effect on students' intention to study and to use education resources in the future. Referring back to Baron and Kenny's (1986) first criteria for mediation, the first criterion that the relationship between the independent and dependent variable be statistically significant (p <.01) is satisfied.

The second model, equation 2, shows that students' germane load is positively correlated with levels of instructional design. This suggests that increasing the levels of instructional design will increase students' levels of germane load. The fact that this equation (Path a) is significant satisfies the second criterion for mediation. Models 1 and 2 both offer strong evidence for the significance of instructional design in student outcomes.

The third model has two main findings of interest. First, Model 3 shows that students' level of future behavioral intentions is positively correlated with their levels of germane load (p <.01), which is shown in Path b of Figure 1b. To this end, it was found that the greater students' germane load, the higher their future behavioral intentions. This satisfies the third criterion for mediation. The second finding of interest from model 3 is that, when controlling for germane load, the relationship between instructional design levels and future behavioral intentions disappears (p = >.05). This is referred to as complete mediation and satisfies the fourth criterion for mediation, and establishes that this model meets all the criteria for mediation. When a model is completely mediated, the inclusion of the mediation variable (Path c) completely removes the relationship between the independent and dependent variable.

These three models and 4 paths, give strong evidence of a mediation effect (Path c'). This implies that the correlation between instructional design and students' future behavioral intentions is illusory (Path c) and is best understood as instructional design affecting students' germane load (Path a), which in turn affects students' future behavioral intentions (Path b).

Table 2: Mediation Table

	Equation 1	Equation 2	Equation 3
	future behavioral intentions (Path c)	germane load (Path a)	future behavioral intentions (Paths b & c')
Instructional design	.23*	.47*	.03
germane load			.52*
Constant	3.73	3.44	2.14
F value	12.78	32.02	27.08
Adjusted r^2	.15	.31	.39
N	1314	1314	1314

Note * = p < .01

5. Discussion

The results support hypothesis H1, which predicted that levels of instructional design would positively correlate with future behavioral intentions. This is important in light of research that promotes the use of instructional design to continue using e-learning (Lee 2010; Wiggins 1998). Although research has promoted instructional design to increase future behavioral intentions, past research lacks the investigation of specific instructional design features included in Anderson et al.'s (2001) model. Relationships were found between cognitive load and instructional design that focused on interaction between the students and development of

social ties (Cheng et al. 2011; Liu et al. 2009), but not on the development of instructional design used to set the overall plan of the course. Specifically, this study found a relationship between future behavioral intentions and instructional design that set the overall plan of the course by clearly communicating course topics, objectives, goals, due dates, and how to use the online system. These instructional design decisions likely contributed to a useful learning experience, creating an interest among the students to continue using e-learning in the future. Based on these results, conclusions can be made that e-learning instructional design should focus on transparent ways of presenting the curriculum within a course in order to promote future use of such a course.

Hypothesis H2 was supported by the results of this study, in that levels of instructional design were positively correlated with germane load. This is consistent to research promoting instructional design that leads to higher germane load (Cierniak et al. 2009; Sweller et al. 1998). Research has looked at ways of doing this through instruction designed to minimize irrelevant or redundant information, as well as to avoid creating a split attention effect among the students (Chandler & Sweller 1991; Mayer & Moreno 1998). This study, however, appears to be the first to examine the relationship between germane load and ways in which instructors set the overall course. Providing students with clear instructions of how to use the e-learning system, as well as clearly communicating course topics, goals, and establishing time lines most likely contributed to keeping the students focused on information directly related to the intended learning process of the class, further leading to an enhanced understanding of what was being taught. This is important for instructors who wish to design instruction that enhances levels of germane load.

The results of this study also support H3, in that levels of germane load were positively correlated with levels of future behavioral intention. Although no research was found connecting the two, the results from this study are not surprising because germane load is directly linked to learning and student understanding of delivered instruction (Cierniak et al. 2009; De Jong 2010; Kolfschoten et al. 2010; Shadiev et al. 2015; Sweller et al. 1998). It is reasonable to assume that, if students perceive an overall positive learning experience through understanding of instruction, they would most likely want to continue with that type of learning in the future. Furthermore, like germane load, elements of future behavioral intentions are reflective of learning. Perceived ease of use and perceived usefulness have been found to contribute to learning, as well as actual intention to use (Lee et al. 2009). Because germane load also has a relationship with learning, it would be reasonable to assume that it would also contribute to future behavioral intentions. Although other research has tied cognitive load to future behavioral intentions, this appears to be the first study to connect levels of germane load to levels of future behavioral intentions.

Finally, the results of this study support H4, in that the effect of instructional design on future behavioral intentions was mediated by germane load. It is clear through past research that future behavioral intentions is positively affected by instructional design (Cheng et al. 2011; Lee 2010; Liu et al. 2009; Wiggins 1998). However, previous research lacks investigation into what is mediating such an effect. Through the results of this study, it can be concluded that higher levels of germane load contribute to the relationship between instructional design and future behavioral intentions. This makes sense because if students' germane load levels are increased through effective use of instructional design, they will most likely intend to use e-learning in the future. The results from Liu et al. (2010) allude to this idea, in that when students received instruction designed to reduce overall cognitive load, they showed higher levels of intention to use. Rather than simply promoting low cognitive load inducing instructional design to promote continuance of usage however, the present study actually examines the mediating effect that germane load specifically has on students' future behavioral intentions. This is important because it provides empirical evidence that higher germane load mediates the relationship between instructional design and future behavioral intentions, providing instructors with justification to promote germane load by implementing instructional design geared to set the overall plan of an e-learning course. Additionally, these findings are particularly important in the context of MOOC-like courses due to the high dropout rate occurring within MOOCs. Using Anderson etal's (2001) instructional design model may encourage students to continue using MOOCs due to increased levels of germane load.

6. Conclusion

Using survey analysis of students who participated in formal online learning in Korea, this study looked at relationships between the following variables: instructional design and future behavioral intentions, instructional design and germane load, germane load and future behavioral intentions, as well as the

mediating effect of germane load on the relationship between instructional design and future behavioral intentions. The relationships were all positively correlated and germane load was found to be a mediating variable between instructional design and future behavioral intentions. Using Anderson et al.'s (2001) model, instructional design was viewed as a way of communicating important information to students about the overall plan of an e-learning course. The results show the importance of delivering such instructional design to promote understanding of course instruction to a point where students will continue using e-learning in the future. The typical goal of instructional design is to promote better understanding of concepts so that effective learning can occur (Cierniak et al. 2009; Sweller et al. 1998). In the present study, the instructional design decisions to establish clear instructions of how to successfully use the e-learning course appear to have contributed to a better understanding based on high levels of germane load. Therefore, it is important for instructors who want to promote e-learning use in the future to also communicate a clear overall plan of the course in a way that will effectively contribute to the learning process.

Although relationships were found that can be helpful in the design and implementation of e-learning, there are some limitations. The relationships found in this study can be further supported through the design of specific experimental conditions that may give a clearer overall picture of what is actually going on within the e-learning environment. Also, further investigation into other aspects that may be affecting cognitive load levels would contribute to a better understanding between the relationships. Additionally, a qualitative approach to this study may provide more detailed information about how the specific instructional design decisions relate to increased levels of germane load and further contribute to students' future behavioral intentions. This study, although useful for MOOC-like courses occurring in Korea, would also be useful in other regions of the world to see if cultural variations influence the results. Although there are some limitations, the fact that relationships were found between all of the variables and the fact that germane load was found to be a mediator of the relationship between instructional design and future behavioral intentions is useful for instructors who seek ways of promoting a positive learning experience and intention to use.

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