The impact of learning management systems on academic performance: Virtual Competency and student Involvement

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This study is to examine the impact of LMS on academic performance using virtual competency theory and student involvement theory. To do so, the current study develops a research model utilizing theories in information systems and education disciplines to examine the moderating effect of virtual competency and the mediating effect of academic involvement on the relationships between LMS usage and academic performance. To test the research model, 113 college students were surveyed. Partial least squares (PLS) structural equation modeling was employed to analyze the data and these analyses provided empirical support for the proposed hypotheses. We believe our model extends our knowledge of (1) the traditional theories related to LMS, (2) the impact of LMS usage on academic performance, and (3) moderator and mediator in the relationships between LMS usage and academic performance.

INTRODUCTION

Recent developments in technology have increased our ability to communicate and collaborate over long distances. As technology continues to improve, the workplace and the classroom continue to transform with introduction and combination of new technologies. In addition, the increasing proliferation of computers and smartphones has allowed us to expand the bounds of the workplace, as face-to-face communication is no longer the only option. This has led to the invention of the virtual workplace, where people widely separated by geographic boundaries are able to work together as a single organization using virtual environments, computer mediated communication (CMC), and other methods of long distance communication (Wasko et al. 2011).

The way that technology has changed the workplace also carries over into the learning environment. Many universities already offer online courses and use a learning management system (LMS) which is a set of tools and features designed to facilitate coursework and learning (Dahlstrom and Bichsel 2014). Online courses allow students the opportunity to pursue educational achievement at a distance even though they cannot reach the physical location of the campus. Furthermore, hybrid courses take advantage of LMS and distance learning allowing for students face-to-face interaction with their instructors. It is even an increasing trend for teachers to use an LMS as part of a traditional course, which provides many opportunities for both student and teacher to increase learning engagement (Dahlstrom and Bichsel 2014).

As universities are beginning to recognize the value and utility of learning management systems (LMS), there is a wealth of research related to LMS including student perceptions of LMS (Bhagat et al. 2016), immersive virtual worlds (Wasko et al. 2011), and how the learning profiles of individual students impact the effectiveness and ideal use of LMS (Dias and Diniz 1989). A lot of research has also been done on the implementation of learning management systems (Avsec and Kocijancic 2016; Georgouli et al. 2008) and how instructor and faculty attitudes impact the implementation and effectiveness of LMS (Lochner, et al. 2015). Multiple researchers have found evidence that LMS usage increases academic

performance (Ebardo and Valderama 2009, Nair and Patil 2012). Georgouli et al. (2008) suggest that a well implemented LMS increases academic performance. Cavus (2007) provides research that indicates the effectiveness of LMS at increasing academic performance. Shapley et al. (2010) investigate that the success of the implementation of technology systems and the impacts on involvement and academic success. Mandernach et al. (2006) examine that time spent using LMS increases academic achievement.

Even though the relationship between LMS and academic success has been the subject of some research over the years, there is still much to learn about this relationship. Especially, there is not enough research on the factors determining success and increased academic achievement when using LMS.

This paper addresses these issues. This paper identifies virtual competency as a moderating influence on the relationship between LMS and academic performance to explain how virtual competency affects academic achievement within an LMS system. By studying student's individual virtual competency, this paper further develops the understanding of the relationship between LMS and academic achievement.

The remainder of this paper is organized as follows. The next section reviews research on academic achievement, LMS, and virtual competency and presents the hypothesis. After which, the next section will discuss the methodology used in testing the research model. Then the paper will end with a discussion of the results, contributions for research and practice, and suggestions for future research.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Technology is becoming more prominent in student's lives. Today learning management systems have become common place in most higher education institutions (Dahlstrom 2014). More students than ever are experiencing this digital learning environment. Dahlstrom (2014) explores that students reported positive dispositions toward information technology (64%), positive attitudes toward information technology (71%), and high levels of information technology usage (70%). This information is further supported in the finding that the majority of students prefer courses that are a blend of online and face-to-face work. This research shows that students are embracing the new culture of academic LMS (Dahlstrom 2014).

Studies have found a positive relation between student technology use and academic performance. For example, in 2010, Shapley studied implementation of technology immersion in high schools, the goals of the study were to demonstrate the effectiveness of the implementation method. Shapley's research showed that students involved in the technological initiative had increased performance in the form of standardized tests than those who did not (Shapley 2010). This information can be used to support the claim that technology and learning systems enhance the learning environment.

Research shows that time spent on course work in an online learning environment positively relates to academic performance (Mandernach et al. 2006). Two factors that that relate to the amount of time spent in an online course are active involvement in the course and effective time management. Instructors report that the most successful online students participate early, participate often, and allow enough time in their schedules to ensure effective completion of all aspects of the course (Mandernach et al. 2006). The use of LMS and the features that it provides can involve students and help to increase their academic performance in these online courses.

The availability of course materials that LMS provides positively impacts the ability for students to learn in and outside of the classroom. The learning skills of students has improved in courses where LMS are available (Nair and Patil 2012). This improvement in learning can be attributed to the learning environment that LMS provides and the access to course material and instant results that allows students to pursue knowledge in a more efficient manner (Ebardo and Valderama 2009). Additionally, the communication that LMS provides between students and instructors allows for feedback and comments on work completed help to promote healthier academic goals in students course work.

Ebardo (2009) claims that information technology increases academic performance with his study on the use of LMS in a higher education environment. In his study two groups of students took the same class taught by the same professor where the first group had no access to LMS and the second group had access to LMS. His research showed that the use of LMS increased academic performance. Features that

an LMS provides such as online interaction, course materials availability and immediate assessment feedback positively contributed to the academic performance of the students (Ebardo and Valderama 2009). This wealth of research and evidence points towards the first hypothesis, that LMS usage increases academic performance.

H1. LMS usage is positively associated with academic performance.

This shift in work and learning paradigm requires an equal shift in our understanding of these processes. Wang proposes a concept known as Virtual Competency, or individual virtual competence. Virtual Competence is an end user's ability, skills, motivation, and knowledge that contribute to their ability to effectively function using virtual skills and tools within a virtual environment (Wang and Haggerty 2011). Wang proposes that virtual competence is composed of three dimensions, virtual self-efficacy, virtual media skill, and virtual social skill (Wang and Haggerty 2006).

Self-efficacy is a general term and can be applied to many contexts. Generally, self-efficacy refers to one's estimation of their capabilities of performing (Bono and Judge 2003.) The self-efficacy theory states that individuals develop their own view of their personal self-efficacy from past experiences with similar tasks, viewing others perform similar tasks successfully, social persuasion, and emotional state (Staples et al. 1998). Zajacova (2005) uses the term academic self-efficacy to describe self-efficacy and its effects on academic outcome. An extensive body of research has shown that academic self-efficacy is positively related with academic performance (Zajacova et al. 2005).

The social cognitive theory states that self-efficacy influences performance because it determines the persistence and effort of individuals when undertaking tasks (Bandura 1989, Wang and Haggerty 2011).

Self-efficacy is an individual's belief in their ability to engage in certain behaviors; then, virtual self-efficacy is an individual's belief in their ability to function and communicate effectively in a virtual environment, and accomplish tasks individually and cooperatively (Wang and Haggerty 2006). Virtual self-efficacy then can be further divided into computer self-efficacy, and remote work self-efficacy. Computer self-efficacy is the confidence of an end user that they can effectively use a computer to accomplish work in a broad sense. Remote work self-efficacy represents an individual's confidence in their ability to complete work remotely, outside of a face-to-face environment and through using information communication technologies (ICT) to work jointly and cooperatively (Wang and Haggerty 2009). Since self-efficacy is a flexible concept that can be applied widely in many different settings, LMS self-efficacy would be an individual's belief in their ability to use and succeed in using a learning management system. It is our hypothesis that LMS self-efficacy is an important concept related to student success in LMS.

H2. LMS self-efficacy positively moderates the relationship between LMS usage and academic performance such that the high levels of LMS self-efficacy will strengthen this relationship, with the strongest relationship occurring when LMS self-efficacy and LMS usage are both high.

Virtual social skill is an individual's ability to communicate in a virtual setting (Wang and Haggerty 2006). The ability to communicate, as well as develop and maintain relationships with others in the workplace is an essential aspect to a healthy work environment (Wang and Haggerty 2011). However, remote work is becoming a more common occurrence, where individuals communicate with others through communication technology such as email and social networking (Wang 2009).In Jarvenpaa and Leidner's 1998 research they detailed the difficulties of developing trust between co-workers in a virtual environment, which is a large factor when it comes to effective interpersonal communication (Jarvenpaa and Leidner 1998). Given the nature of the communication medium, Information Communication Technologies (ICT) and Computer Mediated Communication (CMC) usual conversation mechanics such as tone and facial expressions are lost or harder to understand. Thus, In order to retain these relationship building mechanics individuals must work to develop and learn stronger virtual social skills. An example of this awareness is an understanding of textual communication techniques, such as emoticons, italicized

phrases, offset quotations, and exclamation marks or other ending punctuation. These and other virtual communication skills are important to effectively communicating using ICTs (Wang and Haggerty 2009). Students must be able to communicate effectively to succeed in the virtual learning environment. Therefore, we hypothesize that student virtual social skill is an important element in the success of students using LMS.

H3. Virtual Social Skills positively moderate the relationship between LMS usage and academic performance such that high levels of Virtual Social Skill will strengthen the relationship, with the strongest relationship occurring when Virtual Social Skill and LMS usage are both high.

Virtual media skill describes how well an individual can communicate using technologies. Where virtual self-efficacy is a person's perceptive skill level, and virtual social skill is the ability to communicate in a virtual environment, Virtual Media Skill deals with an individual's actual ability to use technology in a task effective manner (Wang and Haggerty 2009). Wang defines virtual media skill as the individual's skill at using features of information communication technologies (ICTs) to their full potential in order to facilitate communication (Wang and Haggerty 2006). Virtual media skill is an important asset in virtual work because virtual work depends on effective communication through ICTs (Wang and Haggerty 2011). Since LMS systems introduce virtual work and communication to the learning environment, it follows that virtual media skill would be an important factor of success when it comes to academic achievement in LMS. We hypothesize that Virtual media skill is important to the success of students in using an LMS, and further, that VMS can be further divided into four categories of media skill: Email Skill, Simple Notification System (SMS) skill, Instant Messaging skill, and Video Conferencing skill.

H4. Virtual Media Email Skill positively moderates the relationship between LMS usage and academic performance such that high levels of Virtual Media Email Skill will strengthen the relationship, with the strongest relationship occurring when Virtual Media Email Skill and LMS usage are both high.

H5. Virtual Media SNS Skill positively moderates the relationship between LMS usage and academic performance such that high levels of Virtual Media SNS Skill will strengthen the relationship, with the strongest relationship occurring when Virtual Media SNS Skill and LMS usage are both high.

H6. Virtual Media Instant Messaging Skill positively moderates the relationship between LMS usage and academic performance such that high levels of Virtual Media Instant Messaging Skill will strengthen the relationship, with the strongest relationship occurring when Virtual Media Instant Messaging Skill and LMS usage are both high.

H7. Virtual Media Video Conferencing Skill positively moderates the relationship between LMS usage and academic performance such that high levels of Virtual Media Video Conferencing Skill will strengthen the relationship, with the strongest relationship occurring when Virtual Media Video Conferencing Skill and LMS usage are both high.

RESEARCH DESIGN AND METHODOLOGY

Instrument validation

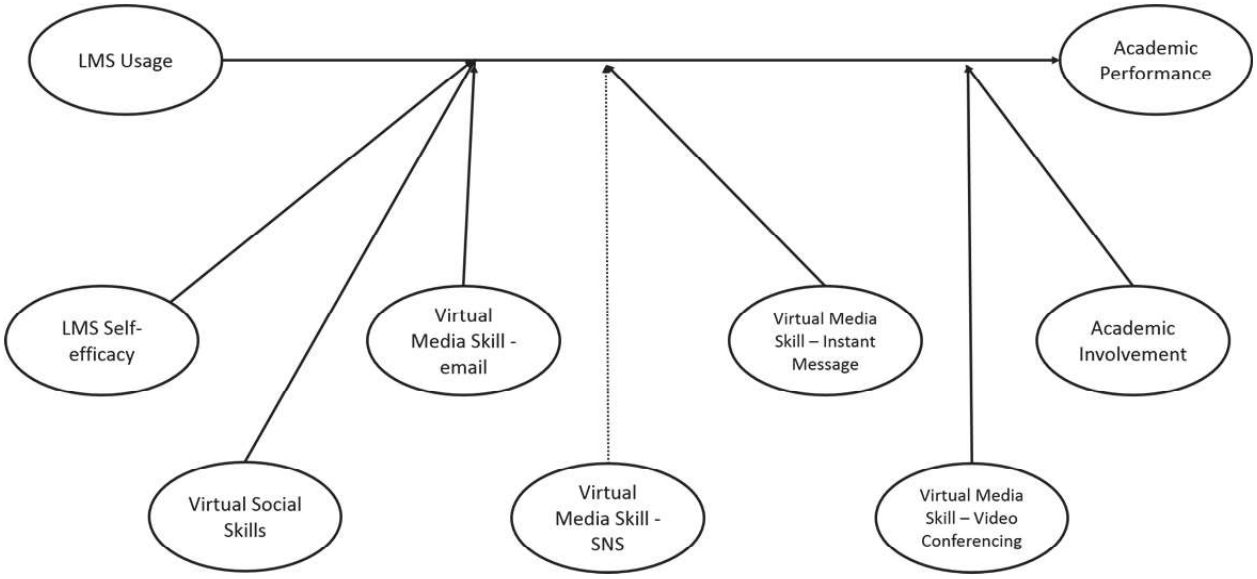
In table 1, question items for measuring the independent and dependent variables are listed in the following sections and are based on a 5- point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree).

TABLE 1
MEASUREMENT

Constructs	Measurement
LMS self-efficacy	Using a new learning management system, I could complete my academic activities such as assignments, tests, and quizzes if I had only the manuals for reference.
	Using a new learning management system, I could complete my academic activities such as assignments, tests, and quizzes if I could call someone for help if I got stuck.
	Using a new learning management system, I could complete my academic activities such as assignments, tests, and quizzes if I had seen someone else using it before trying it myself.
Virtual Social Skill	In virtual settings, I am keenly aware of how I am perceived by others.
	In virtual settings, I am good at making myself visible with influential people in my school.
	In virtual settings, I find it is simple to put myself in other people's positions to understand their point of view.
	In virtual settings, I always know what to say to others in social situations.
	In virtual settings, I am particularly good at sensing the motivations and hidden agendas of others.
Virtual media skill - Email	To what extent do you feel you are capable of using email to give and receive timely feedbacks when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of using email to convey multiple types of information (e.g., factual information, emotional information) when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of using email to transmit varied symbols (e.g., words, numbers, and pictures) when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of tailoring the message to fit other parties' requirements when using email to communicate with people whom you are not able to meet in person?
SNS	To what extent do you feel you are capable of using social networking sites to give and receive timely feedbacks when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of using social networking sites to convey multiple types of information (e.g., factual information, emotional information) when communicating with others whom you are not able to meet in person?

Constructs	Measurement
	To what extent do you feel you are capable of using social networking sites to transmit varied symbols (e.g., words, numbers, and pictures) when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of tailoring the message to fit other parties' requirements when using social networking sites to communicate with people whom you are not able to meet in person?
Instant Message	To what extent do you feel you are capable of using instant message to give and receive timely feedbacks when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of using instant message to convey multiple types of information (e.g., factual information, emotional information) when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of using instant message to transmit varied symbols (e.g., words, numbers, and pictures) when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of tailoring the message to fit other parties' requirements when using instant message to communicate with people whom you are not able to meet in person?
Video conferencing	To what extent do you feel you are capable of using video conferencing such as FaceTime to give and receive timely feedbacks when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of using video conferencing such as FaceTime to convey multiple types of information (e.g., factual information, emotional information) when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of using video conferencing such as FaceTime to transmit varied symbols (e.g., words, numbers, and pictures) when communicating with others whom you are not able to meet in person?
	To what extent do you feel you are capable of tailoring the message to fit other parties' requirements when using video conferencing such as FaceTime to communicate with people whom you are not able to meet in person?

FIGURE1
RESEARCH MODEL



Primary Data Collection

All respondents were university students in their sophomore, junior, or senior years. Students were recruited through a Management Information Systems course that students from a cross-section of general business majors were required to take. A total of 147 students were surveyed and a total of 135 complete and valid surveys were received (91.8%). The large response rate was likely due to the extra credit that was offered to students who completed the survey. The age of respondents varied from 18 to 31 years and 67 percent were from the ages 18 to 25. 59 percent of the respondents were female. Table 2 shows demographic information about the respondents.

TABLE 2
RESPONDENTS DEMOGRAPHICS

Demographics (n=135)	Frequency	Percentage
Age		
Under 20	91	67%
20-29	43	32%
30-39	1	1%
Gender		
Male	56	42%
Female	79	58%

Measurement

Reliability of items was checked by examining each item's loading on its corresponding construct. Barclay et al. (1995) suggested that the item loading should exceed 0.70, and the loading of each item in our study met this criteria except one variable (Table 3). Convergent validity was assessed by (1) reliability of items, (2) composite reliability of constructs, and (3) average variance extracted (AVE). As shown in Table 4, composite reliability of constructs exceeded the recommended required minimum of

0.80. Further, AVE, which measures the amount of variance that a construct captures from its indicators relative to the amount due to measurement error (Komiak & Benbasat, 2006), for all constructs exceeded the threshold value of 0.50 (shown in Tables 4). Hence, all three conditions for convergent validity were met. Discriminant validity between constructs was assessed using the relationship between correlations among constructs and the square root of AVEs. As Tables 5 and 6 show, the square root for all the AVEs were greater than the correlations among the constructs, indicating that the discriminant validity criterion was met for all constructs.

Table 3 Cross loading

	ACP	LMS	LSE	VSS	VMSE	VMSS	VMSM	VMSV
Grade	1.00	0.45	0.06	-0.07	0.22	0.19	0.08	0.15
Level	0.34	0.76	-0.15	-0.05	0.01	-0.08	-0.10	0.02
Number of Login	0.24	0.71	-0.04	0.08	0.03	-0.05	-0.06	0.06
Time	0.35	0.63	-0.03	-0.12	0.05	-0.02	0.01	-0.08
Q3_2	0.04	-0.07	0.78	0.19	0.24	0.15	0.03	0.09
Q3_4	0.03	0.04	0.60	0.05	0.25	0.19	0.21	0.04
Q3_5	0.05	-0.13	0.83	0.11	0.19	0.31	0.26	0.18
Q5_2	-0.01	0.02	0.17	0.57	0.21	0.06	-0.08	0.15
Q5_3	-0.08	-0.02	0.15	0.92	0.13	0.15	-0.10	0.14
Q5_4	-0.05	-0.10	0.16	0.78	0.10	0.21	0.01	0.22
Q6_1	0.27	0.03	0.34	0.17	0.93	0.43	0.48	0.39
Q6_2	0.16	0.12	0.26	0.14	0.83	0.51	0.50	0.32
Q6_3	0.13	-0.03	0.26	-0.01	0.83	0.46	0.56	0.43
Q6_4	0.06	-0.03	0.13	0.20	0.71	0.34	0.36	0.43
Q7_1	0.20	-0.09	0.35	0.20	0.47	0.94	0.62	0.45
Q7_2	0.09	-0.01	0.32	0.19	0.52	0.85	0.57	0.36
Q7_3	0.11	-0.08	0.19	0.17	0.42	0.81	0.53	0.33
Q7_4	-0.05	-0.11	0.21	0.21	0.40	0.64	0.47	0.34
Q8_1	0.10	-0.09	0.26	-0.07	0.55	0.62	0.95	0.37
Q8_2	0.02	-0.01	0.27	0.05	0.53	0.60	0.82	0.41
Q8_3	0.07	-0.07	0.24	-0.11	0.53	0.60	0.91	0.29
Q8_4	0.06	-0.05	0.14	-0.03	0.44	0.52	0.84	0.25
Q9_1	0.09	-0.06	0.18	0.14	0.44	0.37	0.40	0.91
Q9_2	0.09	-0.04	0.18	0.17	0.47	0.42	0.35	0.90
Q9_3	-0.05	-0.10	0.15	0.04	0.36	0.22	0.32	0.50
Q9_4	-0.02	-0.13	0.15	-0.01	0.39	0.26	0.36	0.58

Notes:

ACF: Academic Performance; LMS: Learning Management Systems Usage; LSE: Learning Management Systems Self-efficacy; VSS: Virtual Social Skill; VMSE: Virtual Media Skill- Email; VMSE: Virtual

Media Skill- Social Network; VMSE: Virtual Media Skill- Instant Message; VMSE: Virtual Media Skill- Video Conferencing.

TABLE 4
CORRELATION MATRIX MODEL

	ACP	LSE	LMS	VMSE	VMSM	VMSS	VMSV	VSS
ACP	1.00							
LSE	0.06	0.85						
LMS	0.45	-0.11	0.70**					
VMSE	0.22**	0.33**	0.04	0.83***				
VMSM	0.08	0.25***	-0.07	0.57***	0.88			
VMSS	0.19**	0.34***	-0.07	0.52***	0.65***	0.82***		
VMSV	0.15**	0.17**	-0.01	0.44***	0.35***	0.44***	0.74***	
VSS	-0.07	0.18**	-0.06	0.15**	-0.07	0.20**	0.21**	0.77***

Notes:

1. ACF: Academic Performance; LMS: Learning Management Systems Usage; LSE: : Learning Management Systems Self-efficacy; VSS: Virtual Social Skill; VMSE: Virtual Media Skill- Email; VMSE: Virtual Media Skill- Social Network; VMSE: Virtual Media Skill- Instant Message; VMSE: Virtual Media Skill- Video Conferencing.

2. ***p<0.001; ** p<0.01; *P<0.05.

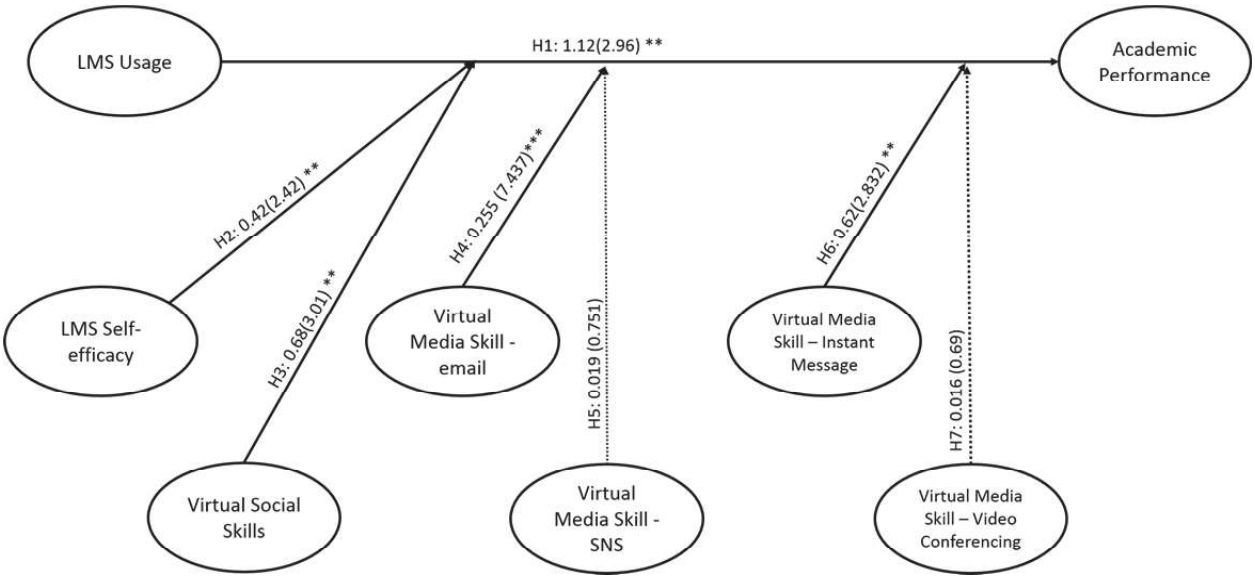
3. Diagonal elements are the square root of the shared average variance extracted (AVE) between the construct measures and their measures; off-diagonal elements are correlations between constructs.

Data Analysis and Results

PLS (partial least squares, SmartPLS V3) was used for the data analysis. Structural equation modeling (SEM) analysis was chosen over regression analysis, because SEM can analyze all of the paths in a model in one analysis. Within SEM, PLS was chosen over LISREL because this study aims at theory development instead of theory testing - whereas LISREL requires a sound theory base, PLS supports exploratory research.

We employed a bootstrapping method (200 times) that used randomly selected subsamples to test the PLS model. Figures 2 shows the results of the PLS analyses. As hypothesized, LMS usage is positively and significantly associated with academic performance ($\beta = 1.12, p<0.01$) LMS Self-efficacy ($\beta = 0.42, p<0.01$) and virtual social skills ($\beta = 0.68, p<0.01$) positively moderates the relationships between LMS usage and academic performance. Virtual media skills: 1) email ($\beta = 0.225, p<0.001$) and 2) instant message ($\beta = 0.62, p<0.01$), as moderators strengthened the relationship between LMS usage and academic performance.

FIGURE2
RESULTS OF PLS



Notes:

1. ***p<0.001; ** p<0.01; *P<0.05.

CONCLUSION

Discussion

In our study, we attempted to further explain the relationship between LMS usage and academic achievement in college students. Our goal was to study the theory of Individual Virtual Competency and its impacts on the relationship between LMS and academic achievement. In doing so, we examined research related to LMS, academic achievement, and individual virtual competency. Through our research, we proposed seven hypotheses to be tested with our research model. Out of seven hypotheses, our results support five of them: the relationship between LMS and academic achievement and the positive moderating effects of LMS self-efficacy, Virtual Social Skill, and Virtual Media SNS Skill, and Virtual Media Instant Messaging Skill on this relationship. This suggests that Individual Virtual Competency is an important moderator of the relationship between LMS and academic achievement.

Implications

This study contributes to current research in two different ways. First, it establishes the correlation between individual virtual competency (IVC) and academic achievement through learning management systems (LMS) usage. Additionally, this study further elaborates on the factors contributing to IVC and examines how they individually contribute to the moderating factor IVC has on academic achievement using LMS.

The current research also offers suggestions to practitioners for increasing academic achievement in courses using LMS. Since IVC has proven important as a concept impacting academic achievement in these courses, instructors should aim to assist students in these areas. LMS Self-efficacy, being an individual's confidence with LMS, is increased over time by exposure to LMS systems. Instructors can

potentially help students gain virtual media and social skills by providing related training materials; whether in the form of tutorials for communication systems, or classroom sessions where students walk through activities, or through other methods that increase access to information for students.

Limitation

The dataset, though thorough, was not extensive nor exhaustive. The students in this study were all taking a Management Information Systems course, and members of the college of business, indicating a fairly homogenous dataset. A study using a different and/or more extensive dataset might return substantially different results. In addition to repeating the same research with additional datasets, further research could expand upon how individual virtual competency impacts learning in an LMS. This could be accomplished either by expanding the research model, or by identifying sources of aptitude in the different areas contributing to IVC such as self-efficacy, media skill, and social skill.

Conclusion

This research provides evidence on the importance of individual virtual competence on learning achievement in a learning management system. While this paper provides some insights on which factors of IVC contribute most to academic achievement, it also reveals further questions that need to be answered. It is hoped that this paper will contribute to understandings of academic learning in LMS, and provide further motivation for research in this area.

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