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Understanding Faculty Use of Learning Management Systems in U.S. Higher Education

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Understanding Faculty Use of Learning Management Systems in U.S. Higher Education

A Dissertation Presented

by

MINGHUI TAI

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
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College of Education

Mathematics, Science, and Learning Technologies

Understanding Faculty Use of Learning Management Systems in U.S. Higher Education

A Dissertation Presented

By

MINGHUI TAI

Approved as to style and content by:

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DEDICATION

I dedicate this dissertation to the loving memory of my mother, Qui-Lan Yang.

Although she was only in my life for 17 years before she passed away from cancer, she

always emphasized the importance and values of education. She inspired and encouraged

me to pursue a doctoral degree. I wish she could see me complete this program.

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This has been a long and bumpy journey. However, the support and love I received along the way has made all the difference.

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ABSTRACT

UNDERSTANDING FACULTY USE OF LEARNING MANAGEMENT SYSTEMS

IN U.S. HIGHER EDUCATION

SEPTEMBER 2023

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The purpose of this dissertation is to understand why and how faculty use a learning

management system (LMS) and what demographic factors and barriers influence faculty

LMS use in U.S. higher education. Nearly 98.1% of higher education institutions in the

United States have invested in at least one LMS to facilitate student learning and faculty

teaching (LMS Data, 2023). However, there have been a limited number of studies

exploring factors that influence U.S. faculty use of LMS. Faculty ($n =$191) across the

United States responded to an online survey answering open-ended, and Likert-scale

questions about LMS use, as well as questions about demographics. Fifteen participants

were selected for in-depth follow-up interviews. The results show two consistent reasons

why and how faculty use LMS: *hosting course materials* and *communicating with*

students. Interestingly, *facilitating learning activities* was rarely mentioned. These results

imply that LMSs are more commonly seen by faculty members as administrative and

logistical tools than as instruments for facilitating student learning. Viewed through the

lens of the PICRAT model, a recently developed technology integration model that not

only focuses on the technology and the instructor but also includes student interaction with the technology, LMS utilization is mainly at the lower-left corner of the matrix, Passive-Replacement (PR). Faculty members should be encouraged to investigate and use LMS features beyond administrative responsibilities, allowing students to engage in interactive and collaborative learning experiences. The other major components of the dissertation looked at barriers that hindered and demographic factors that affected LMS integration. First-order barriers included *lack of features in LMS, lack of time,* and *navigation issues*. Second-order barriers included *comfort level with figuring out how to use an LMS, beliefs about how learning happens,* and *pedagogical beliefs*. The impediments that have been found, particularly those that concern usability, feature limits, and faculty comfort, emphasize areas that could use improvement and support to increase faculty integration of LMS platforms and involvement. Lastly, while gender did not influence LMS utilization, age and experience were found to be factors affecting LMS use. The results highlight the need for extensive training and professional development support programs.

Keywords: Learning Management Systems (LMSs), PICRAT model, barriers to technology integration, faculty, U.S. higher education

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background and Statement of the Problem

With the Internet's revolution and rapid technological developments, many new technologies have been used to support teaching and learning. Currently, a variety of technological tools are available for educators to connect with students and deliver educational content in exciting ways. A learning management system (LMS) is one type of technological tool that is used to help teaching and learning practices. A recent report showed that nearly 98.1% of higher education institutions in the United States have invested in at least one LMS to facilitate student learning and faculty teaching (LMS Data, 2023).

There are various definitions for LMS in the field of educational technologies. Ellis (2009) gave a basic description of an LMS: "a software application that automates the administration, tracking, and reporting of training events" (p. 2). Gautreau (2011) defined an LMS as "a self-contained webpage with embedded instructional tools that permits faculty to organize academic content and engage students in their learning" (p. 2). An LMS can provide several features and allow instructors to share digital course content, teach online courses, collect assignments, post grades, create quizzes, and assign students activities for collaboration. From the standpoint of students, an LMS can help students access course content, submit assignments, receive feedback from instructors, communicate with other students at a certain level, and collaborate on assigned activities.

One of the advantages of an LMS is to provide a learning and teaching environment without the restrictions of time, location, and distance (Chaubey & Bhattacharya, 2015). With its flexibility and ease of access, students are allowed to study course materials at their own pace on digital devices with an Internet connection anytime, anywhere. LMS has been shown to facilitate face-to-face classroom instruction (Lonn & Teasley, 2009). In addition, it is one of the most important technologies in online programs (Legon & Garrett, 2017).

Since the COVID-19 virus threatened the world in the middle of March 2020, institutions of higher education in the United States have had to make challenging decisions to move instruction online to maintain public safety. With the advancement of technology, LMSs served as virtual classrooms, providing online learning with continuity during the crisis (Raza et al., 2021). However, the term "online learning" can be confusing, especially for this dramatical change of course delivery caused by the COVID-19 pandemic. Hodges et al. (2020) discussed the distinctions between emergency remote teaching (ERT) and online learning. ERT is defined as:

> A temporary shift of instructional delivery to an alternative delivery mode due to crisis circumstances. It involves the use of fully remote teaching solutions for instruction or education that would otherwise be delivered face-to-face or as blended or hybrid courses and that will return to that format once the crisis or emergency has abated. The primary objective in these circumstances is not to re-create a robust educational ecosystem but rather to provide temporary access to instruction and instructional support in a manner that is quick to set up and is reliably available during an emergency or crisis. (para. 13)

Online learning, on the other hand, is designed purposefully to be distant and involves "careful instructional design and planning, using a systematic model for design and development" (Hodges et al., 2020, para. 7). Hodges et al. (2020) argued that a well-designed online course could take six to nine months for development and follow nine dimensions for course planning: modality, pacing, student-instructor ratio, pedagogy, role of online assessments, instructor role online, student role online, online communication synchrony, and source of feedback. By understanding the differences between ERT and online learning, using an LMS to facilitate instruction during the COVID-19 pandemic could be categorized into three course delivery methods—in-person, ERT, and online learning—depending on the different reopening plans in institutions of higher education.

Over the years, an enormous amount of research has been conducted to determine factors that influence the faculty adoption of LMS outside of the United States (Almaiah et al., 2020; AlQuadh, 2014; Bervell & Umar, 2017; Fathema & Sutton, 2013; Fathema et al., 2015; Gierdowski & Galanek, 2020; Goh et al., 2014; Wichadee, 2015). However, there have been a limited number of studies exploring factors that influence U.S. faculty use of LMS. In addition, most studies have explored factors that impact instructor use of LMS by using statistical models to examine the correlations between variables (AlQuadh, 2014; Fathema et al., 2015; Gierdowski & Galanek, 2020; Goh et al., 2014). Although the statistical method is useful in providing a broad view, there is a need to collect qualitative data to deepen the understanding of how factors shape faculty use of LMS. As Gautreau (2011) argued, faculty are motivated to use LMS for different reasons. Understanding why and how faculty use an LMS, and factors that may impact faculty use of LMS can

help professional development departments and information technology (IT) departments at universities support faculty LMS integration.

1.2 Purpose of the Study

The purpose of this study was to understand why and how faculty use LMS, and what demographic factors and barriers influence faculty LMS use in U.S. higher education. To meet this purpose, this research: 1) explored why and how faculty used an LMS through an online survey; 2) investigated demographic factors that influenced faculty LMS use through an online survey; 3) explored more detailed and comprehensive responses about faculty LMS integration barriers through in-depth interviews; and 4) analyzed the relationship between demographic factors and barriers to technology integration. By examining the current perceptions and practices of faculty's LMS integration, this study aims to identify factors and challenges influencing faculty's LMS use in the setting of U.S. higher education. The findings will contribute to the existing body of knowledge and can inform the development of effective strategies and skills for integrating LMS for faculty professional development institutes that support faculty's teaching.

1.3 Significance of the Study

This study contributed to an understanding of the factors that impact faculty LMS integration in U.S. higher education. Recent studies on faculty LMS integration have been widely conducted outside the United States; however, little research has been done on LMS integration in U.S. higher education. In addition, most technology adoption

studies regarding LMS use have widely applied the Technology Acceptance Model (TAM), an information systems theory that examines how users come to accept and use a technology, but little research has been done on using a technology integration model to understanding instructors' and students' relationship to technology.

In this study, I applied the PICRAT model to examine faculty's LMS use. While there are many technology integration models, I chose the PICRAT model for this study as it is the model that not only focuses on the technology and the instructor but also includes student interaction with the technology. The exploration of faculty's usage of LMS examined through the PICRAT model in this study, would be beneficial to faculty professional development initiates who seek to find a relevant approach to guide faculty to self-reflect and improve their level of LMS use.

1.4 Summary

In this chapter, I explained the problem statement concerning how little research has investigated why and how faculty use an LMS, and factors that may influence faculty's LMS integration in U.S. higher education. The purpose of this study was to explore why and how faculty use an LMS and the barriers that faculty may experience when using an LMS. I used the PICRAT model as a framework to guide this study, as this model helps to examine both instructors' and students' relationship to technology. This study provided data that will help the improvement of faculty LMS integration in U.S. higher education.

CHAPTER 2

LITERATURE REVIEW

This chapter summarizes selected literature related to factors influencing LMS adoption and barriers to faculty's technology integration. The literature review is divided into two sections and examines empirical research studies that took place between 2011 and 2020. The first section describes why faculty use LMS and factors that positively influence faculty's technology adoption. I also discuss factors with a positive impact on technology adoption found in the Technology Acceptance Model (TAM). In the second section, I focus on the barriers that negatively impact faculty's technology integration with LMS in higher education. The barriers are discussed as first-order and second-order based on Ertmer's (1999) definition.

2.1 Why do Faculty Use Learning Management Systems in Their Courses?

Faculty need to accept a new technology first before they have developed any intention to adopt a new technology. Researchers have tried to develop theories and identify factors that may influence a user's technology adoption (Davis, 1989; Venkatesh & Davis, 2000). Scholars have investigated different factors that influence faculty adoption of LMS by using TAM (AlQuadh, 2014; Fathema et al., 2015; Gierdowski & Galanek, 2020; Goh et al., 2014). TAM is an information system theory that is widely applied to model factors that influence an individual's technology adoption. The original model (see Figure 1) was introduced by Fred D. Davis (1989) to display how users come to accept and use a new technology. The assumption of an individual's intention to use a technology in the model is determined by two major variables: its Perceived Usefulness

(PU) and Perceived Ease of Use (PEOU). Davis (1989) defined PU as "the degree to which a person believes that using a particular system would enhance his or her job performance" (p. 320). This means that the individual needs to see the technology as useful for what they want to do in their work before they consider using it. PEOU refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). This means that an individual is more likely to adopt technologies that are easy to use.

Figure 1

The Technology Acceptance Model
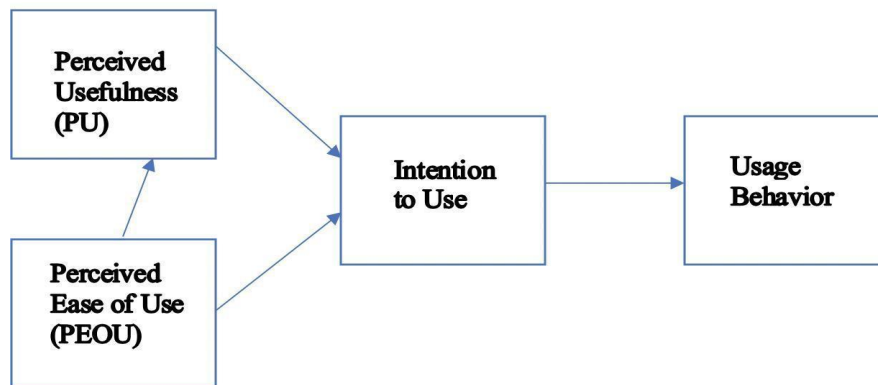
Note. This figure is adapted based on the proposed TAM from Davis (1989).

The TAM has been continually expanded and elaborated as scholars have defined external variables as determinants to affect the PU and PEOU of technology adoption. Venkatesh and Davis (2000) noted that external variables such as Job Relevance and Subjective Norm can influence PU, which in turn can influence a person's attitude and

behavior toward using a technology (see Figure 2). In Venkatesh and Davis' (2000) expanded model (TAM2), they noted that PU can be influenced by PEOU, which means that when a user finds a technology easy to use, they may perceive that technology to be useful. Both PU and PEOU influence the user's attitude toward using a technology, which means that when a user finds a technology easy to use and considers it useful to their work, they develop a positive attitude toward the technology. PU and Attitude Toward Using (ATT) directly influence a user's behavioral intention (BI), which is the degree of motivation to plan to use a technology, and then this leads to the actual system use (AU).

Figure 2

TAM2, the Expanded TAM
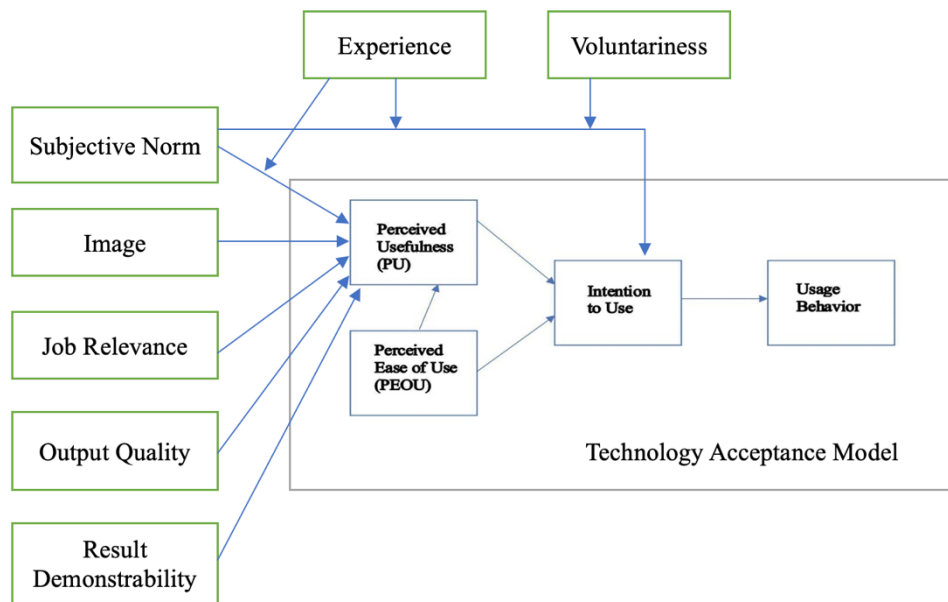
Note. This figure is adapted based on the proposed extension of the TAM from Venkatesh and Davis (2000).

In order to identify the factors that have a greater impact on *perceived usefulness*, the TAM2 (Venkatesh & Davis, 2000) included seven additional external variables. These seven variables can be categorized into two constructs: social influence processes, and cognitive instrumental processes. The variables involved in social influence processes are 1) subjective norms, 2) image, 3) experience, and 4) voluntariness, while the variables involved in cognitive instrumental processes are 5) job relevance, 6) output quality, and 7) result demonstrability.

The definitions of the variables involved in social influence processes are as follows: 1) subjective norm refers to "a person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein & Ajzen, 1975, p. 302); 2) image refers to "the degree to which use of an innovation is perceived to enhance one's status in one's social system" (Moore & Benbasat, 1991, p. 195); 3) experience is identified as "the direct effect of subjective norm on intentions may subside over time with increased system experience" (Venkatesh & Davis, 2000, p. 189); and 4) voluntariness refers to "the extent to which potential adopters perceive the adoption decision to be non-mandatory" (Venkatesh & Davis, 2000, p. 188).

The definitions of the variables involved in cognitive instrumental processes are as follows: 5) job relevance is defined as "an individual's perception regarding the degree to which the target system is applicable to the individual's job. In other words, job relevance is a function of the importance within one's job of the set of tasks the system is capable of supporting" (Venkatesh & Davis, 2000, p. 191); 6) output quality is identified as "tasks a system is capable of performing and the degree to which those tasks match

their job goals (job relevance), people will take into consideration how well the system performs those tasks" (Venkatesh & Davis, 2000, p. 191); and 7) result demonstrability refers to "tangibility of the results of using the innovation" (Moore & Benbasat, 1991, p. 203).

Researchers have implemented the TAM model in different fields to examine the causal relations among different external variables that may influence a user's acceptance of new technology (Lee et al., 2003). The current literature has tended to show that the TAM model can be used in an educational setting to examine possible external variables that influence faculty's acceptance of using LMS. In the next section, I will discuss the current literature describing what external variables have been found to influence PU and PEOU in the TAM model and how these external variables influence faculty's acceptance and use of LMS.

2.1.1 Job Relevance Influences PU

Job relevance is considered one of the factors that positively influences PU. Venkatesh and Davis (2000) defined job relevance as "an individual's perception regarding the degree to which the target system is applicable to the individual's job. In other words, job relevance is a function of the importance within one's job of the set tasks the system is capable of supporting" (p. 191). Two studies have investigated instructors' perceptions on an LMS supporting their jobs. Goh et al. (2014) examined the perceptions of instructors in using Moodle for teaching at a private university in Malaysia. The results showed that lecturers felt Moodle to be useful for uploading teaching materials, posting announcements, and downloading students' assignments. This

study showed that instructors may consider Moodle useful because it supports their job, serving as a platform for hosting teaching materials. Similarly, Gierdowski and Galanek's (2020) also reported that research has consistently shown that course management functions in the LMS are the most common uses for faculty. Faculty use LMS as a tool to manage course materials for its functionality and usefulness.

2.1.2 Self-Efficacy Influences Both PU and PEOU

McDonald and Siegall (1992) defined technological self-efficacy as "the belief in one's ability to successfully perform a technologically sophisticated new task" (p. 467). For instructors, self-efficacy refers to the belief in their ability to effectively maintain course tasks and activities, to handle obligations and challenges, and to play a role in influencing students' academic outcomes (Bandura, 1977; Barni et al., 2019). Self-efficacy can influence instructors' perceptions of technology usage in classrooms (Albion, 2001).

Fathema et al. (2015) found that faculty's self-efficacy regarding their ability to use an LMS has a positive effect on both PEOU and PU. This finding indicates that faculty members with higher self-efficacy and confidence on their LMS skills perceived LMS to be easy to use and useful. Some studies have shown that facilitating conditions (training) have significant positive effects on PEOU (McGill et al., 2011; Teo, 2010). However, Fathema et al. (2015) found that facilitating conditions (training) have a weak effect on PEOU, which is in contrast with results in other studies. Fathema et al. (2015) argued that it is possible that if faculty members received a high quality LMS and have high self-efficacy, they may not perceive the necessity for training in order to effectively

utilize their LMS. However, to increase faculty self-efficacy, many researchers still suggest that universities should offer extensive training, workshops, and online help for LMS to improve faculty's technological skills in order to ensure that faculty perceive LMS as easy to use (Dahlstrom et al., 2014; Fathema & Sutton, 2013).

2.1.3 System Quality Influences Both PU and PEOU

System quality (e.g., functions, content, navigation speed, and interaction capability) is another factor that can influence the PU and PEOU of LMS. Fathema et al. (2015) conducted an online survey to investigate whether the proposed external variable, system quality, influences faculty's LMS usage. They used Structural Equation Modeling (SEM) to analyze causal relationships among the factors from 560 faculty survey responses in the United States. The results suggested system quality had a significant positive effect on both PU and PEOU. The findings indicated that system quality can influence faculty's technology acceptance of LMS usage.

2.1.4 Technical Support Influences Both PU and PEOU

AlQuadh (2014) collected survey data to examine faculty attitudes toward using Moodle at a university in Jordan. They examined the external variable, technical support, and whether it has an impact on faculty's PU and PEOU. Technical support is defined as access to e-mail or fax when there is a technical problem with Moodle, the availability of a technical problem hotline at any time, and good technical support from the Moodle technical team (AlQuadh, 2014). The results suggested that technical support has a positive effect on both PU and PEOU. This study indicated that when faculty can find

access to report their technical problems and receive help from the technical team, they are more likely to feel that Moodle is useful and easy to use.

2.1.5 Summary

Scholars have investigated different factors that influence faculty adoption of LMS by using the TAM model (AlQuadh, 2014; Fathema et al., 2015; Gierdowski & Galanek, 2020; Goh et al., 2014). Findings from the literature indicate that job relevance, self-efficacy, system quality, and technical support are external factors that positively influence faculty's perceptions of the usefulness and ease of use of an LMS. While the TAM and TAM2 has been used to focus on factors that make faculty adopt the technology, especially applying statistical methods, such as SEM to validate the causal relationship among variables in the models, little attention has been paid to understand how an LMS is used. Few empirical studies have explored qualitatively why and how faculty used an LMS. Additionally, it remains unclear what might obstruct faculty's LMS adoption.

2.2 Factors That Negatively Influence Faculty Use of Learning Management Systems

There are several variables that can negatively influence or obstruct technology adoption by educators. Ertmer (1999) identified first-order and second-order barriers to explain teachers' difficulty in technology integration. First-order barrier refers to external factors that impact teachers' technology integration, such as equipment, resources, time, technical support, and training. Second-order barrier refers to factors internal to the

teacher, such as beliefs about teaching and learning, attitudes about educational

technology, and unwillingness to change.

Scholars have identified a number of factors that influence faculty use of LMS,

including technical issues, time, student use, training, beliefs about and attitudes toward

LMS, and unwillingness to change (Al Meajel & Sharadgah, 2017; AlQuadh, 2014;

Gierdowski & Galanek, 2020; Goh et al., 2014; Saleem et al., 2016; Stanley, 2015;

Wichadee, 2015; Xu & Mahenthiran, 2016). Looking at Ertmer's (1999) barriers to the

use of technology in teaching, faculty use of an LMS can be influenced by both first-

order barriers (technical issues, time, student use, training) and second-order barriers

(belief, attitudes, unwillingness to change).

2.2.1 First-Order Barrier: Technical Issues

Technical issues, such as Internet disconnects or slowdowns, LMS navigation

issues, and lack of immediate LMS support services, play a significant role in shaping

faculty use of an LMS. Al Meajel and Sharadgah (2017) surveyed faculty in Saudi Arabia

regarding the barriers that influenced their use of Blackboard in their courses. Faculty

reported several technical issues that they encountered. First, the Internet disconnecting

or slowing down as the number of users increased was an obstacle that reduced their use

of Blackboard. Second, faculty found that Blackboard had many tools that were difficult

to follow. For example, the interface was hard to navigate because the links, buttons, and

word symbols were confusing. Third, there was no available ongoing technical support,

affecting faculty's willingness to use Blackboard. The results showed that faculty

intention to use Blackboard was affected by technical problems and a lack of immediate support for solving technical issues when using it.

2.2.2 First-Order Barrier: Time

The feeling that a technology was time-consuming was another factor that caused faculty to have no intention to use an LMS (Saleem et al., 2016). Studies have suggested that the feeling of using an LMS being time-consuming is caused by high teaching loads, the need to deal with technical issues, student problems, and difficulty of use. Al Meajel and Sharadgah (2017) reported that faculty members who already had high teaching loads did not have additional time to use Blackboard in teaching. The results showed that it was too time-consuming for faculty because they had to spend quite a bit of time solving technical problems or student problems of any kind when using Blackboard during class.

Another learning management system, Moodle, also raised the same time-consuming issue to faculty. AlQuadh (2014) found that faculty felt it required a lot of time to upload course materials to Moodle for students, especially for very large files. Instructors had to edit or manipulate the file before uploading it to Moodle, which was time-consuming and reduced faculty intention to use Moodle. Goh et al. (2014) also found that faculty did not find Moodle functions easy to use and that it required a lot of time to use because several steps were needed to complete a task.

2.2.3 First-Order Barrier: Student Use

Recent research has shown that faculty intention to use LMS is influenced by students. Al Meajel and Sharadgah (2017) discovered that students who are not interested

or who are not motivated to use Blackboard affect faculty members' willingness to utilize Blackboard. Goh et al. (2014) also reported that faculty find that students seldom log in to Moodle. Faculty also reported that it is slow and difficult to reach students or to interact with students using Moodle. Faculty tend to use other social networking tools, such as Facebook, to host online discussion sessions with students. The two studies have demonstrated that student use impacts faculty intention to use LMS; however, faculty use of LMS can affect student intention to use LMS as well. Gierdowski and Galanek (2020) found that students wanted faculty to use LMS. They reported that courses in LMS are organized and easy to navigate. Students find it is frustrating when a course site is not organized and when it is time-consuming to locate course materials that are put all over the place. One student even reported that they would not take classes with instructors who did not use LMS because the program made education more convenient, effective, and easier.

Recent studies have tended to show that students and faculty affect each other's intention to use LMS. Perhaps when addressing the intention to use LMS, attention should also be on whether students and faculty share the same purpose of using LMS. In Goh et al.'s (2014) study, the faculty purpose of using Moodle was to interact with students and host an online discussion; since students barely logged in to Moodle and did not treat Moodle as a primary tool for social interaction, the faculty switched to using other technological tools that students used more often for the purpose of social interaction. In Gierdowski and Galanek's (2020) study, the student purpose of using LMS was to be able to easily access course content and materials; therefore, they tended to be frustrated if faculty did not use LMS for the purpose of managing course content and

materials. Also frustrating to students were faculty who did not keep the course site organized and user-friendly. Existing research has focused on reporting barriers or factors that affect faculty and student use of LMS but rarely discusses why faculty use LMS and whether faculty and students have the same purpose or expectation for using LMS in learning. Future studies will need to understand whether faculty and students have the same purpose in using the LMS and how this same purpose influences their intention of using LMS.

2.2.4 First-Order Barrier: Training

Many studies have suggested that training is one main factor that plays a role in faculty use of LMS (Al Meajel & Sharadgah, 2017; Stanley, 2015; Wichadee, 2015; Xu & Mahenthiran, 2016). Xu and Mahenthiran (2016) conducted an online survey to investigate factors that influence faculty and student satisfaction using Moodle at a university in the United States. Faculty were easily able to use basic functions, such as adding their syllabi and making courses available. They were able to easily upload files and content to their sites because they received training. However, faculty were less likely to use more advanced features in Moodle, such as Turnitin assignments, graded forum discussions, quizzes, chats, and blogs because they received less training on these advanced features in Moodle.

Wichadee (2015) discovered factors that impact instructors use and adoption of Moodle in their courses. Wichadee (2015) gave a survey to 62 instructors at a private university in Thailand to follow up their use of Moodle after attending training. The majority of faculty ($n = 42$) reported that they were quite able to use the system without

difficulty after the training. Faculty also stated that students should receive training to learn how to use Moodle as well so that class time could be used effectively without wasting it on showing students how to use Moodle. Wichadee's (2015) study suggested that Moodle training is important for both faculty and students.

Al Meajel and Sharadgah (2017) investigated barriers for faculty to use the Blackboard system in teaching and learning at a university in Saudi Arabia. The results from their online questionnaire suggested that faculty who received limited or no training had more obstacles when using the Blackboard system. However, their lack of training was because the training sessions were held at inappropriate times, not because there was no training offered by the university. The results from faculty responses also indicated that a lack of adequate training for students using Blackboard was another obstacle for faculty using Blackboard. This result was similar to Wichadee's (2015) finding, which suggested that faculty and students all need adequate training to use LMS.

While studies have suggested that training impacts faculty use of LMS (Al Meajel & Sharadgah, 2017; Wichadee, 2015; Xu & Mahenthiran, 2016), Stanley (2015) seemed to indicate that providing training did not significantly influence LMS use for faculty who had never used it before. Stanley (2015) conducted an online survey and follow-up interview to examine whether Professional Development (PD) initiatives had an impact on faculty use of Moodle in a private university in Japan. PD programs were designed not only to show faculty how to use all the features in Moodle but also why they would use it and how using Moodle would benefit their teaching both in the short term and long term. The statistical results suggested that PD initiatives lead to significantly increased Moodle use for faculty who were already using Moodle but did not significantly lead to increased

use for faculty who had never used Moodle before. Interview responses revealed that faculty who had never used Moodle tended to seek help and ask technical questions about Moodle from their colleagues who were good at using Moodle or good at technology instead of directly seeking help from PD initiatives. Another interview response from a non-Moodle faculty user showed that he never used Moodle and switched off whenever conversations turned to Moodle during the PD initiatives; therefore, the PD initiatives had no direct impact on him.

The study results from Stanley (2015) indicated that faculty who never used Moodle before did not have a direct positive impact on using Moodle from PD initiatives; however, they sought help from other resources they felt comfortable with (e.g., their colleagues who were good at Moodle or other faculty who were good at technology) and started to use Moodle. This suggests that training plays an important role in influencing faculty use of LMS, whether the training is formally provided or informally sought out.

Faculty who attended PD training but who switched off conversations about Moodle during the PD initiatives tended to show that, other than training, there could be other possible factors that impact faculty intention to use LMS. Perhaps intrinsic factors such as belief or attitude toward LMS became the primary barriers that impacted faculty intention to use LMS.

2.2.5 Second-Order Barrier: Beliefs

Faculty beliefs, particularly about teaching and learning, tend to reflect what they do in the classroom and choices they make regarding technology integration (Angers & Machtmes, 2005; Webb & Cox, 2004). AlQuadh (2014) found that faculty who had no

intention to use Moodle and Blackboard believe that using Moodle would add little value to the student learning process. Saleem et al. (2016) revealed that faculty who rejected using Moodle believed that it did not effectively improve students' learning outcome and skills. In Wichadee's (2015) study, faculty reported that students did not pay much attention to the downloaded materials in LMS and were not responsible for the self-study assigned. This caused a big burden for faculty because they had to spend more time mentoring student work. This led faculty to believe that using LMS did not make their teaching more efficient or improve student learning. Recent studies have tended to show that when faculty do not believe that LMS use would facilitate their instructional goals, they have no intention to incorporate LMS in their teaching (AlQuadh, 2014; Saleem et al., 2016; Wichadee, 2015).

2.2.6 Second-Order Barrier: Attitude

Attitude towards LMS could be one of the intrinsic barriers to faculty use of LMS. Recent studies have tended to show that faculty have their preferences when choosing other technological tools for teaching instead of using an LMS. Wichadee (2015) found that some faculty rejected using Moodle because they did not find online communication in LMS to work better than direct face-to face meeting with students. Other faculty rejected using Moodle (e.g., discussion board) because other technological tools (e.g., Line, Facebook, blogs, and Twitter) were more effective when interacting with students. Goh et al. (2014) reported similar findings that faculty preferred to use other technological tools, such as Facebook, for online discussion because other technological tools seemed to be able to engage students more than

Moodle. Saleem et al. (2016) also found that faculty used other Internet resources and PowerPoint presentations to replace Moodle for their instructional aids because Moodle is no different from other technological tools. Current studies have tended to show that if faculty do not have a positive attitude that LMS could facilitate their teaching, then they are more likely to choose other technological tools they prefer instead of adopting LMS in their courses (Goh et al., 2014; Saleem et al., 2016; Wichadee, 2015).

2.2.7 Second-Order Barrier: Unwillingness to Change

Current research has indicated that unwillingness to change is one of faculty's intrinsic barriers to LMS adoption. Al Meajel and Sharadgah (2017) found the reason that faculty do not use Blackboard is because they simply resist change. AlQuadh (2014) also found that faculty who are already used to or who are experts in the use of a particular LMS do not like to change or switch to another LMS. Recent studies appear to support that this barrier is intrinsic to people and more difficult to change (Al Meajel & Sharadgah, 2017; AlQuadh, 2014).

2.2.8 Summary

Current research seems to indicate that the factors that impact faculty's LMS adoption can be categorized into first-order and second-order barriers (Ertmer, 1999). First-order barriers refer to obstacles that are extrinsic to faculty, such as technical issues, time, student use, and training. Second-order barriers refer to faculty's intrinsic thoughts, such as beliefs, attitudes, and unwillingness to change. Faculty's LMS usage could be

impacted by more than one factor or influenced by both first-order and second-order barriers at the same time.

2.3 Discussion

Recent research has identified several factors that influence faculty LMS integration. Several studies have applied TAM to describe an individual's acceptance of technology (AlQuadh, 2014; Fathema et al., 2015; Goh et al., 2014). Empirical evidence appears to show that external variables like job relevance, self-efficacy, system quality, and technical support are factors that positively influence faculty's PU and PEOU of LMS.

While there is broad agreement that the TAM model is a powerful scientific method to predict variables influencing technology acceptance, it remains controversial whether the model is sufficient to explain technology adoption. Lee et al. (2003) agreed that "TAM provided a parsimonious model to examine factors leading to information system acceptance… TAM conceptualized usefulness and ease of use as important perceptions leading to intentions to adopt new systems" (p. 765). However, the strength as a parsimonious model is also its weakness. Bagozzi (2007) argued that research focused on extending the TAM model by introducing new variables has broadened it but not deepened it. Researchers seem to have overlooked essential determinants and have focused on tweaking the TAM model rather than on including more important issues in technology integration. Röcker (2010) also argued that the TAM model that has been studied for the past two decades is not sufficient for explaining the adoption of future information and communication technologies. As computer technology has dramatically

22

changed from a personal computer with a single user to working within a system to support multiple people interacting and cooperating to finish tasks, the existing factors in the TAM model that predict technology adoption are not sufficient to explain the adoption of future technology.

The TAM model is an information system theory that hypothesizes and tests relationships among variables that may influence an individual's technology adoption. While this method provides an explanation for the correlation among those variables towards technology integration, it lacks enough understanding of how and why the individual uses a technological tool, as well as how and why those variables shape the individual's use of technology and impact technology adoption.

The review of literature shows that many factors have been identified as barriers to integrating LMS into classes for faculty. Current studies on faculty use of LMS in higher education have identified first-order barriers such as technical issues, time, student use, and training (AlQuadh, 2014; Gierdowski & Galanek, 2020; Goh et al., 2014; Meajel & Sharadgah, 2017; Stanley, 2015; Wichadee, 2015; Xu & Mahenthiran, 2016). Interestingly, one of the first-order barriers, lack of access to hardware and software, was not identified in recent studies. This implies that faculty seem to have no issue accessing computers and learning management systems in their technology integration. This is supported by the recent report that shows that 98.1% of higher education institutions in the United States have invested in at least one LMS (LMS Data, 2023). Another possible explanation could be selection bias. The selection of participants started with faculty who had taught in universities that provided LMS access; therefore, faculty had no barrier of a lack of access to LMS.

Current studies have tended to show that faculty use of LMS is influenced by multiple barriers and can be influenced by both first-order and second-order barriers (Al Meajel & Sharadgah, 2017; AlQuadh, 2014; Goh et al., 2014; Saleem et al., 2016; Wichadee, 2015). While researchers have shown that faculty use of LMS is impacted by different barriers, it remains unclear which barriers are most dominant in influencing or impeding LMS integration. Perhaps it is not easy to distinguish the most influential factor because different factors may be interrelated and influence each other on various levels. However, to understand why faculty use LMS in classes, researchers in the field of educational technology will need to illustrate how factors interact among each other and shape faculty use of LMS.

The review of literature in this section showed how current research has tended to use the TAM model to examine what factors influence technology adoption. While factors in the TAM model are defined, and the relationship among factors and technology adoption have been verified through a structural statistical method, it remains unclear how and why the factors impact technology integration. Existing empirical studies indicate several first-order and second-order barriers (Ertmer, 1999) to technology integration, but it seems difficult to identify the most influential factor that affects technology integration, as various barriers may interrelate and influence how instructors use an LMS.

When addressing technology integration, existing research has tended to either focus on investigating technology adoption through TAM or exploring instructors' barriers to technology integration. The current literature seems to separate the topics and thus fails to address adoption and barriers altogether as a whole when exploring

24

instructors' technology integration. Besides, most existing studies investigating

technology integration barriers have focused on higher education outside the United

States and in-person classes rather that online instructors' use of LMS (Al Meajel &

Sharadgah, 2017; AlQuadh, 2014; Goh et al., 2014; Saleem et al., 2016; Wichadee,

2015). There is limited research investigating barriers to the integration of LMS in higher

education in the United States. Few studies have investigated instructor and student

relationship to technology. The PICRAT model is a technology integration framework

that addresses both instructor and student relationship to technology. The goal of the

present study was thus to explore why and how faculty use an LMS by examining

faculty's LMS use via the PICRAT model to reveal why and how faculty use an LMS

and to unfold the faculty and student relationship to LMS use. I also examined the

relationship between demographic factors and barriers to technology integration in this

study.

CHAPTER 3

THEORETICAL FRAMEWORK

In this study, I applied the PICRAT model (Kimmons, 2016; Kimmons et al., 2020) as the theoretical approach to guide me through the research. The aim of this study was to understand why and how faculty used an LMS in U.S. higher education. The existing literature has tended to use the TAM model (Davis, 1986; Venkatesh & Davis, 2000) with statistical methods to investigate factors that influence faculty's LMS adoption and usage (AlQuadh, 2014; Fathema et al., 2015; Gierdowski & Galanek, 2020; Goh et al., 2014). The TAM model has been criticized for its weaknesses to explain users' behavior and actual use of technology (Ajibade, 2018). Bagozzi (2007) pointed out that research that has focused on extending the TAM model by introducing new external variables has broadened it but not deepened it. The TAM model examines how users come to accept and adopt a technology, but it does not explain users' relationship with a technology when it comes to technology integration.

In the context of U.S. higher education, integrating an LMS into the teaching of a course does not necessarily mean it supports student learning or improves teaching. The integration is only meaningful by taking into consideration the relationship between users (faculty and students) and technology. The PICRAT model (Kimmons, 2016; Kimmons et al., 2020) addresses the complex interconnected relationships among users and technology.

3.1 The PICRAT Model

The PICRAT model (Kimmons, 2016; Kimmons et al., 2020) is a recently

developed technology integration model that expanded upon a Replacement,

Amplification, and Transformation (RAT) framework (Hughes et al., 2006). The RAT

model (see Figure 3) was introduced as a self-reflection tool for teachers to increase

technological decision-making and pedagogical practice. Replacement refers to

technology that serves simply as a different digital means to the same instructional

practices (Hughes et al., 2006). Amplification refers to the tasks staying the same while

the technology increases the efficiency, effectiveness, and productivity of instructional

practices (Hughes et al., 2006). Transformation refers to technology that reinvents new

instruction, learning, or curriculum (Hughes et al., 2006). The PICRAT model extends a

step further than the RAT framework by integrating students' relationship with

technology.

Figure 3

RAT Model
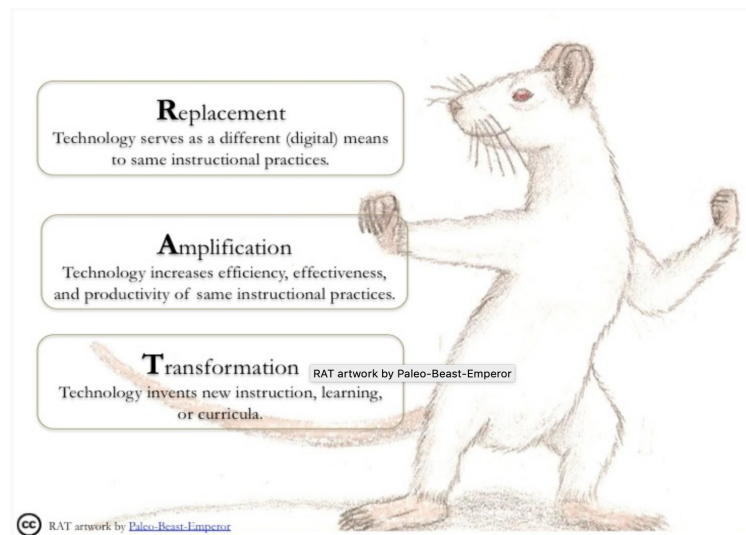
The PICRAT model is represented by a two-dimensional matrix (see Figure 4). Kimmons (2016) suggests two essential questions that need to be asked when using technology, including: 1) What is the students' relationship to technology? (PIC: Passive, Interactive, Creative); and 2) How is the teacher's use of technology influencing traditional practice? (RAT: Replace, Amplify, Transform) (Hughes et al., 2006).

Figure 4

PICRAT Model
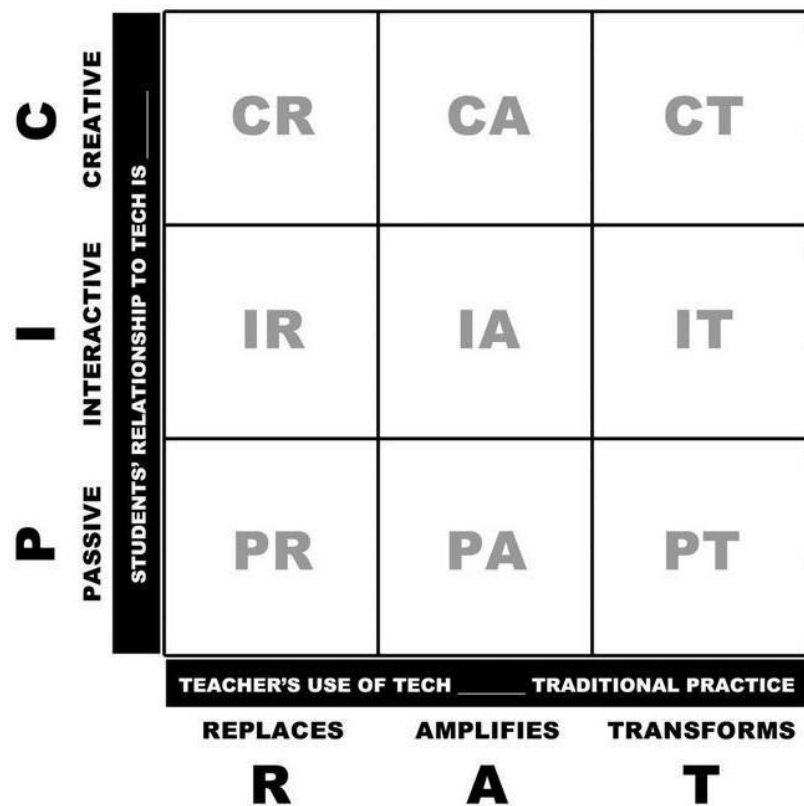
In the PICRAT matrix, the horizonal axis presents the three levels of the RAT (Replace, Amplify, Transform) framework for how technology use affects teachers' practice, while the vertical axis presents what students are doing with the technology (Passive, Interactive, Creative).

Replace refers to changing the appearance or dressing of the practice, but not the practice itself. It does not affect teaching or learning practices and behaviors; however, it can still be a useful use of technology because it can increase access (Kimmons, 2016). For example, a professor uploads a digital form of his/her syllabus to Moodle. In this case, the digital form of the syllabus changes the appearance of the syllabus from the paper version to the electronic version, but it does not affect the teaching; however, it is a useful use of technology because it increases access for students.

Amplify refers to technology that improves the efficiency of tasks or that introduces new functions to the original tasks (Kimmons, 2016). For example, a professor sets up an online quiz with immediate feedback on Blackboard Learn. Students can take the quiz on their own time, and Blackboard Learn can instantly grade the quiz and provide correct answer feedback. In this case, technology improves the task (the quiz) by making it more efficient. The professor does not need to spend a lot of time grading each individual quiz, and students can receive feedback immediately instead of waiting till the next class time.

Transform refers to new activities or learning being introduced, and it is impossible without technology to make it happen (Kimmons, 2016). For example, a journalism professor in the United States creates a Moodle course that is open to a global audience. Students in this class can interact with people around the world via the Forum

29

feature for discussions in Moodle. In this case, the professor is using technology to virtually bring physically distant people around the world to the class for participation that would have been impossible without technology.

The vertical axis in the matrix, PIC (Passive, Interactive, Creative), shows the three student roles in using a technology. These three roles can be defined as follows. Passive means that students are passive observers or bystanders in their learning (Kimmons, 2016). For example, a professor uploads a PowerPoint course material to Moodle and has students read it. In this case, students are inactive receivers of information from that PowerPoint presentation. Interactive means that students are active learners, and they engage in material in an interactive way (Kimmons, 2016). For example, a professor creates a discussion topic on Forum in Moodle and asks students to post their responses to this topic on Forum. In this case, students are interactively engaged in responding to information through using technology. Creative means that students are creative learners, and they create materials themselves (Kimmons, 2016). For example, students collaboratively create their own course glossary via the feature Wiki in Moodle. In this case, students use the technology as a platform to create learning products that represent new information.

According to Kimmons et al. (2020), the PICRAT model is a matrix for teachers to reflect on their technology activities. Though technology activities can be categorized in different grids in the matrix, none of the grids are necessarily inferior to another for teaching. The PICRAT model can be used to encourage teachers to continue reflecting on their practice and thinking about how to move their technology use from the bottom-left (PR) to the top-right (CT) of the matrix.

3.2 Literature on the PICRAT Model

Since the PICRAT model (Kimmons, 2016; Kimmons et al., 2020) is a recently developed new technology integration framework, there is little research on its implementation. The current literature shows that the PICRAT model has been introduced to teacher educators in teacher preparation programs and to K–12 teachers to help them to reflect on and improve technology integration in K–12 settings in the United States. Dillon et al. (2019) reported that the PICRAT model was used in the Teacher Educator Technology Integration Initiative workshop at a U.S. college's teacher preparation program to undergird teacher educators' technology use and explain how to think meaningfully about integrating technology into the classroom. The PICRAT model was introduced to teacher educators to create a common understanding and vocabulary of technology integration through the activities hosted at workshops. The matrix was used to help teacher educators develop the mindsets and skills of effective technology integration practices. The study showed growth in teacher educators' competencies in technology integration supported by the Initiative. The teacher educators felt that they were confident to support teacher candidates to use technology integration within their disciplines. In this case, the PICRAT model was introduced to teacher educators in higher education through a professional development initiative for preparing future K–12 teachers' technology integration in the classroom. While this study reports teacher educators learned the PICRAT model for integrating technology to support teacher candidates' teaching, teacher candidates' self-reflection on integration practices was not further discussed in the research.

Asim et al. (2022) recommended that the PICRAT model be introduced to science teacher educators in teacher preparation programs in the United States. Teacher educators can use the PICRAT model to examine how technology integration can make K–12 classroom activities better and move towards student-centered and transformative learning. The authors encouraged teacher educators to use this approach and support teacher candidates to learn to apply educational technology tools in the teaching of scientific content. Asim et al. (2022) also discussed how teacher educators used an LMS as an example of Passive-Replacement on the PICRAT matrix. For example, most teacher educators now use an LMS provided by their institution to support students' navigation and access of course materials. The features used in an LMS in this case were Passive-Replacement (PR) as students were not asked to interact with the LMS but only used it to access course materials. Teacher educators also used other basic features of an LMS, such as posting assignments for students to access and having students turn in electronic version of assignments. In these cases, the use of an LMS was replacing traditional practices, such as writing assignments on a classroom blackboard and replacing paper versions of assignments from students. In these examples, using an LMS increased access and convenience for teacher educators and students, but it was not amplifying or transformative. The authors further recommended that science teacher educators should show teacher candidates the instructor side of an LMS that students may not usually see or use so that teacher candidates can be ready to use the basic features of an LMS in their teaching. In this case, the study showed that teacher educators tended to use the basic features in an LMS to support student access of course materials, located at the bottom-left corner in the PICRAT matrix. Although Passive-Replacement (PR) was

32

not necessarily a poor practice (Kimmons et al. (2020), the study did not address how teacher educators can transition future K-12 teachers' LMS use from Passive-Replacement (PR) to Creative-Transformative (CT) to improve student learning.

Research by Heberer Jr. (2021) showed that secondary teachers in New York State were able to implement higher levels of technology integration after attending professional development sessions on the PICRAT model. In this study, the researcher collected classroom activities from each teacher and used the PICRAT model as an evaluation tool to examine where activities mapped on to the nine grids of the matrix. Teachers attended an online professional development session on the PICRAT model, and the researcher was the instructor. After the professional development session, Heberer Jr. (2021) asked teachers to provide additional samples of educational technology classroom activities and then mapped them to the PICRAT matrix and compared the classroom activities prior to teachers attending the professional development session and after. The findings showed that 60% of all the post-professional development lesson activities fell within the Creative-Amplifies (CA) or Creative-Transforms (CT) grids compared to 13% before teachers attended the professional development session. The finding suggested that teacher educators should consider introducing the PICRAT model in professional development sessions to their teachers. In this case, the PICRAT model was used as a method for intervention and as an instrument to measure secondary teachers' instructional practice in a professional development session.

A case study conducted by Constantine and Jung (2019) examined an elementary science teacher's iPad integration into his teaching. The teacher received the coaching

partnership from the second author, and the coaching helped the teacher plan critically for how the iPad could be used as a digital science notebook (e.g., Notability app). The researchers used the PICRAT model to analyze the teacher's planning process and implementation of digital science notebooks in his class. The findings showed that the teacher was able to consider his students' relationship to technology and reflect on how he wanted his students to use the digital science notebook to move away from Replacement (digital worksheets) to Amplification (annotated photos) and Transformation (scientific claims). The study suggested that through careful planning, integrating digital science notebooks can go beyond only replacing traditional notebooks; it "can enhance student learning experiences with technology by allowing them the power to become producers, rather than merely consumers" (Constantine & Jung, 2019, p. 392). In this case, the study demonstrated that the PICRAT model was beneficial to an elementary science teacher's planning on integrating technology to the classroom.

Warr et al. (2022) described how they introduced technology integration frameworks to support creative learning design with technologies in an online Master's-level education course in a university in the United States. Most class members in this course were K–12 teachers pursuing a master's degree. One of the technology integration frameworks, the PICRAT model, was used to guide class members to create learning designs on creative and transformative uses of technology. The study showed that only two class members were able to successfully enhance the required curriculum by incorporating technologies in creative and transformative approaches, while many class members who taught in schools with rigid curricula were challenged to move to more transformative and creative uses of technology from the structured "lesson plan." In this

case, the study pointed out that while the PICRAT model helped K–12 teachers improve technology use to more creative and transformative approaches, there might be a challenge for application associated with inflexible and structured school curricula.

The five studies above have tended to show the PICRAT model being incorporated into professional development workshops for teacher educators and teacher preparation programs, as well as in professional development sessions and coaching sessions for K–12 teachers in the United States. Current research appears to support the notion that the PICRAT model is beneficial to teachers for improving technology integration in K–12 settings. While teacher educators seem to be faculty members most familiar with the PICRAT model, there is limited research investigating teacher educators themselves with technology integration in higher education settings.

Since the PICRAT model was mainly introduced to teacher educators and K–12 teachers, little research has investigated how the PICRAT model could support faculty members' technology integration in higher education. In Wang's (2023) study, the PICRAT model was applied in an undergraduate linguistics course in Hong Kong. The instructor employed a wide range of technological tools, such as Zoom, EdPuzzle, Moodle online quizzes, and online discussion forums to facilitate teaching and learning. All these technology-enhanced activities were designed to match different grids of the PICRAT matrix, which helped the instructor replace, amplify, or transform traditional practices. After the course was completed, students in the course were given a survey and follow-up interviews to find out their views on their technology-enhanced online learning experiences. This study suggested that the PICRAT model can be a useful technology integration framework for faculty members to evaluate their use of technology, and

faculty members can turn students from passive learners into interactive and creative learners by adopting technologies systematically to replace, amplify, and transform traditional practices. This study shows that Moodle quizzes and discussion forums were categorized as Interactive-Amplify (IA) in the PICRAT model, as quizzes were adopted to amplify traditional paper-based quizzes, and discussions forums were adopted to amplify face-to face oral discussions in the classroom. Nearly all the students (96.7%) agreed that the quizzes feature in Moodle was helpful in self-assessing their understanding of the course content, and around 83% of the students agreed that the discussion forums provided a platform for meaningful discussion about the course content. In this case, the finding demonstrated that the PICRAT model helped faculty members self-reflect on integrating technology into the design of the learning activities resulting in a positive experience for almost all the students.

Research by Hill (2021) examined how instructors redesigned a Portuguese course as a blended language learning course at a university in the United States. The researcher introduced the PICRAT model to help instructors' pedagogical decision-making process. The findings showed that some Passive-Replacement (PR) adoptions occurred, such as replacing paper-based course materials and some Passive-Amplification (PA) occurred, such as, replacing in-person lectures with video-recorded lectures. In this case, an instructor felt that digital access to course materials provided an advantage for students to access materials conveniently. However, most learning activities fell in the Interactive-Amplifying (IA) grid of the PICRAT model (like the use of H5P, a plug-in tool that helps educators create interactive content, such as interactive videos and quizzes) that facilitated grammar practice and provided immediate feedback to students.

An instructor admitted it would not have been possible to go over all students' answers and automatically correct the grammar at the same time without the technology integration. Another example of amplifying or transformative use of technology found in this study was that instructors used GoReact (a technological tool that allows instructors to create video assignments and leave feedback and grading for students) to facilitate language learning activities such as role play and oral interviews. The instructors and students used to meet in-person at a scheduled time for the activities, and instructors would share some feedback when students finished the activities. With the GoDirect integration, instructors were able to rewind videos, rewatch videos, and give more feedback at specific moments in students' recorded videos without waiting until the end. In this case, the study showed improved course designs after examining learning activities through the lens of the PICRAT model.

The two studies above showed how the PICRAT model was used by faculty members in higher education to guide course activity design when considering technology integration. While Wang's (2023) study showed an example of examining LMS use through the PICRAT model in the higher education setting outside of the United States, Hill's research (2021) demonstrated several other technological tools were incorporated into a college level language class in the U.S. higher education. Little research has been done on investigating faculty members' LMS use in U.S. higher education through the lens of the PICRAT model.

3.3 Theoretical Approach in My Dissertation

While LMS is the technology widely used in most higher education institutions in the United States, there is limited research investigating why and how faculty members use features provided in an LMS. In this study, I employed the PICRAT model (Kimmons, 2016; Kimmons et al., 2020) as the theoretical framework to guide me in interpreting how faculty members use an LMS in their classrooms. Although the literature has focused on how the PICRAT model has been used by teacher educators and K–12 teachers, it seems that the model has not been widely known by other faculty members from different disciplines in higher education. The implementation of the PICRAT model to examine LMS use in higher education has yet to be explored. While there are professional development workshops to help teacher educators and K–12 teachers better understand technology integration through the PICRAT model, few attempts have been made to investigate faculty members' LMS technology integration in the U.S. higher education through the lens of the PICRAT. The exploration of faculty's LMS use examined through the PICRAT matrix in this study would be beneficial to faculty professional development initiatives seeking a self-reflective technology integration framework to support faculty integrating LMS in a more transformative manner.

3.4 Summary

This chapter started with introducing the PICRAT model (Kimmons, 2016; Kimmons et al., 2020), a recently developed technology integration framework. Current literature regarding the implementation of the PICRAT model has shown that the model

is helpful for exploring technology integration. Given that there are no studies looking at LMS adoption through the lens of the PICRAT model in U.S. higher education, my study presents a novel approach that can help improve faculty professional development initiatives' support for faculty technology integration.

CHAPTER 4

METHDOLOGY

4.1 Introduction

The purpose of this study was to explore why/how faculty use an LMS and to understand faculty's barriers to LMS use in U.S. higher education. The demographic factors that may influence faculty's LMS use and barriers that faculty experienced are also identified. In this chapter, I first explain the research questions, followed by a description of the study design, instrument, data collection, participants, data analysis, and limitations.

4.2 Research Questions

In this study, I studied faculty's LMS use, and barriers to technology integration using the PICRAT model as a framework. The following research questions guided this study:

RQ1: Why do faculty use an LMS in U.S. higher education?

RQ1a: What is the relationship between demographic factors and why faculty use an LMS in U.S. higher education?

RQ2: How do faculty use an LMS in U.S. higher education?

RQ2a: What is the relationship between demographic factors and how faculty use an LMS in U.S. higher education?

RQ3: What barriers influence faculty use of LMS in U.S. higher education?

RQ3a: What is the relationship between demographic factors and barriers?

4.3 Research Design and Approach

In this study, I combined both quantitative and qualitative research techniques. The participants first completed an online survey, which provided both qualitative and quantitative data through open-ended survey questions and Likert-scale questions. The online survey also collected data on faculty's demographic information, including educational disciplines, age, gender, teaching experience, experience using digital tools, and experience using an LMS.

After I analyzed the online survey data, I selected participants who met the criteria (See section 4.5.2 Follow-up Interview Participants) and who volunteered to participate in the follow-up interview. I then interviewed them for in-depth qualitative feedback. I asked the interview participants about their LMS use experiences, first-order barrier experiences, and second-order barrier experiences to LMS integration.

Both qualitative and quantitative data served to answer research questions for this study. I used the qualitative data from open-ended questions in the online survey to answer RQ1, RQ1a, RQ2, and RQ2a. I used the qualitative data collected from follow-up interviews to answer RQ3. Finally, I used the quantitative data from Likert-scale questions in the online survey to answer RQ3 and RQ3a. Table 1 represents how the research questions were linked to the types of data I collected in this study.

Table 1

Research Questions and Types of Data

Research questions	Types of data
RQ1: Why do faculty use an LMS in U.S. higher education?	Qualitative data from open-ended questions in the online survey

RQ1a: What is the relationship between demographic factors and why faculty use an LMS in U.S. higher education?	Qualitative data from open-ended questions in the online survey
RQ2: How do faculty use an LMS in U.S. higher education?	Qualitative data from open-ended questions in the online survey
RQ2a: What is the relationship between demographic factors and how faculty use an LMS in U.S. higher education?	Qualitative data from open-ended questions in the online survey
RQ3: What barriers influence faculty use of LMS in U.S. higher education?	Quantitative data from Likert-scale questions in the online survey; qualitative data from follow-up interviews
RQ3a: What is the relationship between demographic factors and barriers?	Quantitative data from Likert-scale questions in the online survey

4.4 Data Collection

The data collected in this study included both quantitative and qualitative data (Creswell, 2008). Data collection activities began after I received the approval letter from the Institutional Review Board (IRB) at the University of Massachusetts Amherst (see Appendix A). I first collected the online survey data, followed by the follow-up interview data. I presented the online survey consent form to participants in Qualtrics and required their agreement to participate in this research before they could start answering survey questions (See Appendix B). I asked each follow-up interview participant for permission to record the entire interview via Zoom, and they could choose not to participate in the study at any time.

4.4.1 Data Collection Instruments

I created a web-based survey on an online survey platform, Qualtrics. Survey questions contain different formats: multiple-choice, asking either for one or all that apply, rating scales, dichotomous questions that ask for a Yes/No answer, 4-point Likert-type scales, 5-point Likert-type scales, and open-ended questions. I developed the survey to identify LMS uses, barriers, and TPACK competency, which all influence faculty LMS integration in U.S. higher education (see Appendix B).

The survey consisted of 52 questions organized into four parts. The first part of the survey asked eight demographic questions. Participants were asked questions regarding their gender, age, educational discipline, years of teaching experience, years of using digital tools for teaching, semester they were currently teaching, courses they were currently teaching, and course delivery methods.

The second part of the survey included seven questions related to LMS use. Participants were asked questions focused on which LMS they used in the most recent semester they taught, years of using an LMS, why and how they use the LMS in open-ended questions, the usefulness of using an LMS, the ease of use using an LMS, features in the LMS that they have used in class.

The third part of the survey was designed to measure barriers that influenced the participants' technology integration. The matrix questions included 10 first-order barrier items and six second-order barrier items designed into closed-ended questions that asked participants to evaluate barriers they encountered when using an LMS as an instructional tool. A 4-point Likert scale included *Not a barrier* = 0, *Minimal Barrier* = 1, *Moderate Barrier* = 2, *A Significant Barrier* = 3. The survey response options in this section were developed to best fit the context of LMS integration in U.S. higher education. The survey

construct followed Ertmer's (1999) definitions of first-order and second-order barriers. I used the pre-existing surveys of barriers to technology integration (Chambers, 2019; Hutchison & Reinking, 2010) as a foundation and resource for the development of survey and response options wording.

The fourth part of the survey was designed to measure faculty's TPACK competency in higher education settings (21 questions). I modified the survey items in this section from the validated HE-TPaCK instrument created by Garrett (2014). The principle for modifying survey items was to keep the original items (Garrett, 2014) that met Mishra and Koehler's (2016) definitions of each TPACK component but to delete extra items that seemed redundant or those for which the wording seemed confusing or not directly tied to TPACK definitions (Mishra & Koehler, 2006). I did not incorporate the TPACK data into this study so will not expound upon it further. The TPACK data was conducted for another research topic.

I designed the follow-up interview questions to understand more about why and how faculty used an LMS. The questions allowed faculty to give more in-depth explanations of their LMS use and the technology integration barriers they encountered based on their responses on the online survey. Table 2 presents the research questions and instruments for data collection.

Table 2

Research Questions and Instruments

Research question	Instruments
RQ1: Why do faculty use an LMS in U.S. higher education?	Survey part 1: demographic information; survey part 2: LMS use, questions 1, 2, 3; follow-up interview

RQ1a: What is the relationship between demographic factors and why faculty use an LMS in U.S. higher education?	Survey part 1: demographic information; survey part 2: LMS use, questions 1, 2, 3; follow-up interview
RQ2: How do faculty use an LMS in U.S. higher education?	Survey part 1: demographic information; survey part 2: LMS use, questions 1, 2, 4; follow-up interview
RQ2a: What is the relationship between demographic factors and how faculty use an LMS in U.S. higher education?	Survey part 1: demographic information; survey part 2: LMS use, questions 1, 2, 4; follow-up interview
RQ3: What barriers influence faculty use of LMS in U.S. higher education?	Survey part 1: demographic information; survey part 3: barriers to technology integration; follow-up interview
RQ3a: What is the relationship between demographic factors and barriers?	Survey part 1: demographic information; survey part 3: barriers to technology integration

4.4.2 Online Survey Data Collection

The online survey was available to faculty for one month from April 17 to May 18 during the Spring 2021 semester. I sent an additional reminder to faculty during the third week from the distribution of the online survey. I exported the online survey data from Qualtrics and downloaded it into an SPSS file after the data collection period expired and then analyzed the quantitative data using SPSS software version 28. I also exported responses from open-ended survey questions to Excel spreadsheets for data analysis.

4.4.3 Follow-Up Interview Data Collection

I used the online survey results to identify 15 follow-up interview participants who met the criteria (See 4.5.2 Follow-up Interview Participants) and who volunteered to be interviewed. I conducted follow-up interviews during November and December 2021.

I sent a follow-up interview consent PDF form (See Appendix C) to the participants via email. The participants agreed to participate in the follow-up interview and signed the consent form. I received the consent form with the participants' signatures before conducting the interview. Each individual follow-up interview lasted between 60–90 minutes. I conducted the interviews via Zoom and video-recorded them with the participants' permission and for transcription purposes. The participants were free to withdraw from the interview at any time if they did not want to continue.

4.5 Participant Recruitment

I sent an invitation to participate in the online survey via email to 400 faculty members in a northeastern research university that offered both LMS options of Moodle and Blackboard, and 55 responded, for a response rate of 13.75%. I also sent the online survey invitation via email to 306 faculty in 50 states of the United States and in Washington D.C. (six faculty in each state along with six in Washington D.C), with 19 responding, for a response rate of 6.2%. The response rate was low compared to the number of faculty who were sent the online survey invitation. I also posted the online survey link on Twitter and Facebook for faculty who were available and willing to complete the online survey during the given time frame. I designed the online survey instrument to screen out whether participants were faculty in U.S. higher education by starting with the statement that the survey was only intended for faculty teaching in a higher education setting in the United States. One introductory question followed to ask participants to answer Yes/No to acknowledge the statement.

I selected the faculty using two types of non-probability sampling: convenience sampling and self-selected sampling (Dillman et al., 2014). Non-probability sampling is also known as non-random sampling; it is the sampling technique through which participants are not chosen at random from the entire population. Because the participants were not randomly selected, the results of the survey were not meant to generalize to the entire population, but rather to offer a more in-depth understanding of faculty's use of LMS in U.S. higher education.

4.5.1 Online Survey Participants

The participants were faculty who had taught and used an LMS in U.S. higher education. This study included 191 faculty who completed the online survey. From the 191 faculty, I selected 15 faculty who had volunteered to participate in the follow-up interviews.

The online survey participants used one of the three popular LMS—Moodle, Blackboard, or Canvas—in the most recent semester they had taught. I collected demographics based on gender, age, years of teaching experience, years of using digital tools, years of using an LMS, and educational disciplines from each study participant. The survey participants consisted of 66 men (35%) and 125 women (65%). There were 71 participants (38%) who reported that they were less than or equal to 40 years old, 60 participants (31%) who were 41 to 49 years old, and 60 participants (31%) who were 50 years old or older. From this sample, 76 participants (40%) reported less than or equal to 10 years of teaching experience, 58 participants (30%) reported having 11 to 20 years of teaching experience, and 57 participants (30%) reported having 20 or more years of

teaching experience. There were 42 participants (22%) who reported having less than or equal to 5 years of teaching with digital tools, 43 participants (23%) who reported having 6 to 10 years of teaching with digital tools, 44 participants (23%) who reported having 11 to 15 years of teaching with digital tools, 33 participants (17%) who reported having 16 to20 years of teaching with digital tools, and 29 participants (15%) who reported having 20 or more years of teaching with digital tools.

Regarding experience using an LMS, 49 participants (26%) reported having less than or equal to 3 years of experience using an LMS, 54 participants (28%) reported having 4 to 6 years of experience using an LMS, 39 participants (20%) reported having 7 to 9 years of experience using an LMS, and 49 participants (26%) reported having 10 or more years of experience using an LMS. Table 3 presents the demographic descriptive statistics.

Table 3

Demographic Descriptive Statistics

Demographic		*n*	*%*
Gender	Man	66	35
	Woman	125	65
Age group	≤ 40	71	38
	41–49	60	31
	≥ 50	60	31
Years of teaching experience	≤ 10	76	40
	11–20	58	30
	20 +	57	30
Years of teaching with digital tools	≤ 5	42	22
	6–10	43	23
	11–15	44	23
	16–20	33	17
	20 +	29	15

Years of using an LMS	≤ 3	49	26
	4–6	54	28
	7–9	39	20
	10 +	49	26

The 191 participants represented 14 educational disciplines with 70 faculty (37%) in the Arts and Sciences (Humanities, Fine Arts, Liberal Arts, and Natural Sciences), 47 faculty (25%) in Education, 22 faculty (12%) in Business/Management, 12 faculty (6%) in Engineering, 11 faculty (6%) in the Social and Behavioral Sciences, 10 faculty (5%) in Public Health and Health Sciences, and 19 faculty (9%) from other disciplines. Figure 5 shows a visual representation of total responses for educational disciplines.

Figure 5

Educational Disciplines
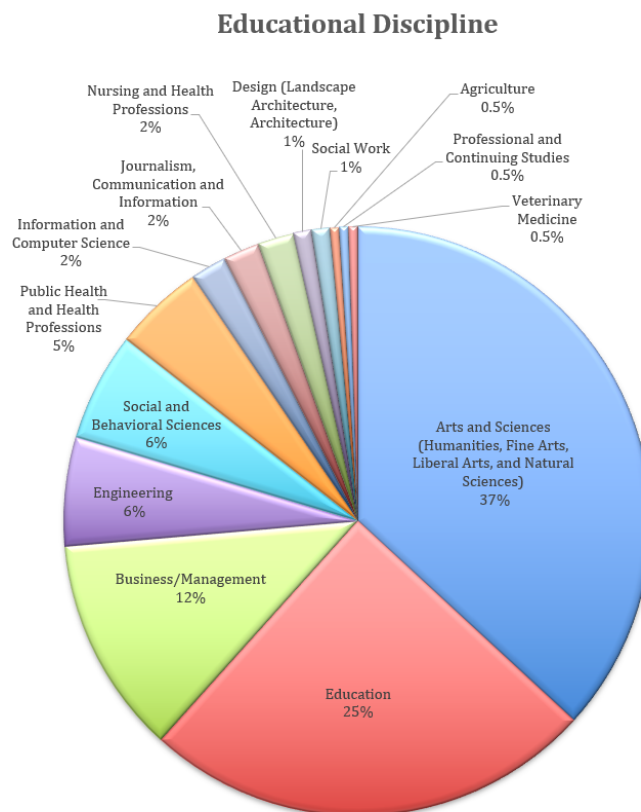
The participants were asked which semester was the most recent semester they had taught. Most participants reported they had taught in Spring 2021 (n = 180; 94.2%), while three participants (1.6%) had taught in Fall 2020; four participants (2.1%) had taught in Spring 2020, one participant (0.5%) had taught in Fall 2019, and three participants (1.6%) had taught in other, earlier semesters. When asked which LMS they had used in the most recent semester they taught, as depicted in Table 4, 63 participants (33%) reported using Moodle, 62 participants (32%) reported using Blackboard Learn, and 66 participants (35%) reported using Canvas.

Table 4

LMS Platforms Used by Faculty in the Most Recent Semester They Taught

LMS platforms used	n = 191	%
Moodle	63	33
Blackboard	62	32
Canvas	66	35

4.5.2 Follow-Up Interview Participants

I invited all the faculty participants to leave their institutional email addresses in the online survey for further contact if they volunteered to participate in a follow-up interview. I designed a semi-structured interview protocol to build on the online survey responses to obtain a more detailed understanding of participants' survey responses about why/how they used an LMS and technology integration barriers they had experienced when adopting an LMS in the classroom (see Appendix D). For example, the participants were asked to share more detailed explanations of reasons why they used an LMS and to display how they used features provided in the LMS. The participants were also asked for

explanations and clarifications of the technology integration barriers that they had encountered (e.g., an example interview question: "You indicated that 'lack of time' was a *moderate barrier* in the survey. Can you tell me more about why that is?"). The follow-up interview questions were open-ended, allowing participants to respond with flexibility and without restriction.

I selected five volunteer faculty members in each LMS platform for the follow-up interview; thus, I selected 15 faculty members total to interview and give more in-depth insights into their thoughts of using an LMS. The interview participants selection process started with analyzing case summaries in SPSS. I computed the participants' mean scores of first-order, second-order, and overall barriers (both first-order and second-order barriers) in SPSS. To obtain participants' views on different types of barriers to technology integration, I selected the five participants in each of the LMS platforms using three criteria. First, I selected two volunteer participants with the highest mean score on first-order barriers in each LMS group who agreed to be interviewed. I then chose the next two participants in each LMS group according to their highest mean score on second-order barriers. Lastly, I chose the fifth participant in each LMS group according to the highest mean score on all barriers.

I used the mean score of first-order barriers as the criteria to select interview participants because it examined how external barriers influence technology use. I used the mean score of second-order barriers as the criteria to select interview participants because this reflected the internal barriers of using technology from the faculty's perspective. Lastly, I used the mean score on all barriers as the criteria to select participants because this reflected faculty perspectives of overall barriers associated with

51

technology integration. Thus, interview participants were all selected from the group of survey participants who volunteered for a follow-up interview; and the criteria were used to determine the final groups, which included for each of the LMS platforms, two participants who encountered the most first-order barriers, two participants who encountered the most second-order barriers, and one participant who experienced the most overall barriers.

I sent the first follow-up interview invitation emails to faculty who met the criteria and who volunteered to be interviewed. If faculty did not reply to the invitation email within seven days, I sent a second invitation email. If faculty did not reply to the second invitation email in the next seven days, I selected the next faculty who had the next highest mean score in that criterion for follow-up interview. Table 5 shows the follow-up interview participants' demographic information and mean scores of barriers to technology integration. The participants' names have been anonymized with pseudonyms for their identity protection.

Table 5

List of Follow-up Interview Participants

Faculty name	Gender	Age	Educational discipline	Years of teaching experience	Years of teaching experience with tech	Years using LMS	First-order barriers (mean)	Second-order barriers (mean)	All barriers (mean)
				Moodle					
Ryan	M	41–44	Natural Science – Urban & Community Forestry	6–10	20+	4–6	1.1	1.0	1.06
Michael	M	41–44	Computer Science	11–15	11–15	7–9	1.3	1.5	1.38
Alice	F	30–34	Education	6–10	16–20	4–6	1.9	0.67	1.44
Ashley	F	50–54	History	16–20	1–5	4–6	0.9	2.0	1.31

Olivia	F	50–54	Film Study	11–15	11–15	7–9	1.2	0.33	0.88
Blackboard Learn									
Yuna	F	30–34	Physical Therapy Program – Neuroscience	1–5	1–5	<1	0.3	0	0.19
Lillian	F	45–49	School of Nursing – Biostatistics	6–10	6–10	4–6	0.1	0	0.06
Smith	M	50–54	Social Science, Psychology	20+	20+	10+	0.8	0.5	0.69
Jessica	F	50–54	College of Social Sciences, Math & Education – psychology	20+	20+ years	10+	0.8	0.67	0.75
Julia	F	45–49	College of Science, Math, Engineering & Technology – Physics and Astronomy	20+	16–20	10+	1.5	1.17	1.38
Canvas									
Cindy	F	41–44	The Design School – Landscape Architecture	6–10	6–10	1–3	1.3	1	1.19
Sonia	F	41–44	College of Liberal Arts – English	11–15	6–10	4–6	1	1.67	1.25
Lucy	F	60+ years	College of Education – Math education	20+	20+	10+	0.3	0.67	0.44
Joseph	M	45–49	College of Education – ESOL and Bilingual Education	20+	11–15	< 1	0.9	0.83	0.88
Caroline	F	30–34	College of Engineering – Engineering Education	1–5	1–5	< 1	0.3	1	0.56

4.6 Data Analysis

I conducted both quantitative and qualitative data analysis to address the research questions for this study. I analyzed the quantitative data using SPSS version 28, and I analyzed the qualitative data using Microsoft Excel spreadsheet. Data analysis was focused on answering the research questions addressed in this study; therefore, it did not

include online survey part four on TPACK or the follow-up interviews associated with TPACK competency.

4.6.1 Quantitative Data Analysis

I analyzed the online survey results for descriptive statistics and inferential analysis. Descriptive analysis included frequencies, percentages, mean, and standard deviation. I calculated frequencies and percentages for the demographic information. This allowed me to understand information about the participants. I also calculated descriptive analysis such as mean and standard deviation for first-order and second-order barrier questions in part three of the online survey. I used the 4-point Likert scale to measure participant responses for first-order and second-order barriers to technology integration. Lower values were associated with a lower level of impact of barriers to technology integration. The descriptive analysis provides an understanding of the level of barriers participants encountered and was used to answer RQ3.

I conducted inferential analysis including Mann-Whitney U tests and Kruskal-Wallis H tests to determine if there were differences in the identification of significant barriers between demographic groups. Due to the ordinal data design in part 3 of the online survey questions and a violation of normal distribution, I conducted non-parametric tests. I conducted Mann-Whitney U tests to compare the differences in the identification of significant barriers between two groups and Kruskal-Wallis H tests to compare the differences in the identification of significant barriers with more than two groups. I used the inferential analysis from part 3 of the online survey to answer RQ3a.

The research questions and their corresponding quantitative data management plan are

shown in Table 6.

Table 6

Research Questions and Quantitative Data Management Plan

Research question	Measure	Independent variable	Dependent variable	Analysis
RQ3: What barriers influence faculty use of LMS in U.S. higher education?	Survey part 3: Barriers to technology integration		Mean of first-order and second-order barriers responses per question item.	Descriptive statistics
RQ3a: What is the relationship between demographic factors and barriers?	Survey part 3: Barriers to technology integration	Gender Age Years of teaching experience Years of using digital tools Years of an using LMS	Mean rank of first-order and second-order barriers responses per question item	Mann-Whitney U tests, Kruskal-Wallis H tests

4.6.2 Qualitative Data Analysis

I conducted a thematic analysis (Braun & Clarke, 2006) using the two data sets

from open-ended questions of the online survey and follow-up interviews. I imported the

open-ended questions of the online survey data into an Excel spreadsheet and analyzed

them to answer RQ1, RQ1a, RQ2, and RQ2a. I transcribed follow-up interview data and

imported it into an Excel spreadsheet as well. I analyzed data from follow-up interviews

to answer RQ 3 and support the descriptive statistics data. The research questions and

their corresponding qualitative data management plan are shown in Table 7.

Table 7

Research Questions and Qualitative Data Management Plan

Research Question	Measure	Analysis
RQ1: Why do faculty use an LMS in U.S. higher education?	Survey part 2: LMS use question 3	Thematic analysis (Braun & Clarke, 2006)
RQ1a: What is the relationship between demographic factors and why faculty use an LMS in U.S. Higher Education?	Survey part 2: LMS use question 3	Thematic analysis (Braun & Clarke, 2006)
RQ2: How do faculty use an LMS in U.S. higher education?	Survey part 2: LMS use question 4	Thematic analysis (Braun & Clarke, 2006)
RQ2a: What is the relationship between demographic factors and how faculty use an LMS in U.S. higher Education?	Survey part 2: LMS use question 4	Thematic analysis (Braun & Clarke, 2006)
RQ3: What barriers influence faculty use of LMS in U.S. higher education?	Follow-up interviews	Thematic analysis (Braun & Clarke, 2006)

The first set of data from the open-ended questions in the online survey was imported into two separate Excel spreadsheets according to two open-ended questions. One question asked why faculty use an LMS (Survey Part 2, Question 3), and the other asked how faculty use an LMS (Survey Part 2, Question 4). In each spreadsheet, I created six columns for each participant's survey responses that included the LMS platform they used, their gender, age, years of teaching experience, years of using digital tools, and years of using an LMS. I transcribed the second set of data from follow-up interviews and imported it into another spreadsheet which also included participants' demographic information and the LMS platform they used. This allowed me to further filter the participant data by the type of LMS they used and their demographic information.

According to Braun and Clarke (2006), thematic analysis consists of six phases: 1) becoming familiar with the data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes, and 6) producing the report (see Table 8). I followed the six phases of thematic analysis as a guide to identify and report

patterns (themes) within both data sets (open-ended questions on the online survey and follow-up interviews).

Table 8

Braun and Clarke's (2006) Thematic Analysis Guide

Phase	Description of the procedure
1. Becoming familiar with the data	Transcribing data, reading and rereading the data, noting down initial ideas.
2. Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes	Combining codes into potential themes, gathering all relevant to each potential theme.
4. Reviewing themes	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2) and generating a thematic map of the analysis.
5. Defining and naming themes	Continuing analysis to refine the specifics of each theme and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating them back of the analysis to the research question and literature, and writing up a scholarly report of the analysis.

4.6.2.1 Qualitative Data Analysis from Online Survey Open-Ended Questions

I followed the first phase of thematic analysis to conduct an initial read of survey responses of why faculty used an LMS to get familiar with the data. Then, I conducted a second read of the survey responses and generated a first round of coding to record the initial impression of the data. A total of 191 faculty reported their comments about why they used an LMS, generating 451 codes, as each individual faculty may have reported multiple reasons for using an LMS. I conducted the third read of the data set and examined the codes. I then organized the total of 451 codes into potential themes that

displayed why faculty used an LMS. Then, I reviewed the potential themes and identified

12 themes that represented reasons why faculty used an LMS. These 12 themes and

selected quotes were used to answer RQ1 and RQ1a and are reported in Chapter 5. In

addition, I examined common reasons why faculty used an LMS through the lens of the

PICRAT model, and these are discussed in Chapter 5.

I followed the same six phases of thematic analysis as a guide to analyze survey

responses of how faculty used an LMS in another Excel spreadsheet. I conducted an

initial read of survey responses to get familiar with the data. Then I conducted a second

read of the survey responses and generated a first round of coding to record the initial

impression of the data. A total of 191 faculty reported their comments about how they

used an LMS, generating 598 codes, as each individual faculty may have reported

multiple approaches for using an LMS. I conducted the third read of the data set and

examined the codes. I then organized a total of 598 codes into potential themes that

exhibited how faculty used an LMS. Then I reviewed the potential themes and identified

eight themes that represented how faculty used an LMS. I used these eight themes and

selected quotes to answer RQ2 and RQ2a, which is reported in Chapter 5. Additionally, I

examined the common approaches of how faculty used an LMS through the lens of the

PICRAT model, and these are discussed in Chapter 5.

4.6.2.2 Qualitative Data Analysis from Follow-Up Interviews

I used thematic analysis (Braun & Clarke, 2006) as a guide to analyze the follow-

up interview data. The first phase entails getting familiar with the data. I read and reread

all the follow-up interview transcripts. The purpose of this first phase was to select and

focus on words and passages that faculty used to describe first- and second-order barriers. I took notes of my first impressions about how faculty addressed technology integration barriers they encountered when using an LMS. Then, I conducted another read of the interview data and generated a first round of coding to record the initial impression of the data. The third phase in thematic analysis was to search for themes. In this stage, I conducted another read of the data set and examined the codes first. Then, I organized the codes into nine subthemes and six major themes that represented faculty's first-order and second-order barriers. I reviewed themes and subthemes and identified three major themes of first-order barriers: 1) lack of features in LMS, 2) lack of time, and 3) navigational issues in the LMS. In addition, the analysis revealed three major themes of second-order barriers: 1) comfort with figuring out how to use the LMS, 2) beliefs about how learning happens, and 3) pedagogical beliefs. I used a total of six major themes, nine subthemes, and selected quotes to answer RQ3 and offered the support descriptive analysis in Chapter 6. Table 9 presents the codebook of RQ3.

Table 9

Codebook for RQ3

Theme	Subtheme	Code	Example/raw data
First-order barriers			
1. Lack of Features in LMS	1.1 Lacking features for real-time social interaction and collaboration	No interaction features	"I think there's not enough of interaction… really happening on Canvas in the real time."
	1.2 Lacking features for programming and math practices	No math problem feature	"I know for physics, one of the things that I really struggle with with Blackboard is it's not set up to do numerical problems very well."
	1.3 Lacking and easy to use Gradebook feature	Hard to use Gradebook	"It's an incredibly complex system."

	1.4 Limitations of posting formats and upload sizes	Video upload size	"I think when you're uploading a video, I think it's generally related to a video. If it's a certain size, Moodle is a little bit particular."
	1.5 Limitations of Visual design	Survey design is dull	"The survey feature in Blackboard was not that conducive, not that easy… easy to design."
	1.6 Poor interface design	Outdated	"It was extremely clunky to set up an exam on Blackboard."
2. Lack of time	2.1 Lack of time due to other work commitments	Planning instruction is priority	"If I have to spend my time trying to figure out how to negotiate Canvas, then that takes away from my time planning effective instruction."
	2.2 Lack of time to spend with tech support staff	Wasting time on waiting for support staff's responses	"Because if I have to learn something new, I have to call this Media Lab and then wait until they talk to me. And sometimes they're incompetent and then it's just hours."
	2.3 Lack of time to figure out how to use all the features	Only spend time to learn features needed	"I think, to me, the time to use Canvas is an investment itself. I also will try to evaluate if I really needed this function and to learn how to use it if that's useful."
First-order barriers			
3. Navigation issues in LMS		A lot of clicks	"There's just a lot of clicking to do what seems to be a very simple thing."
Second-order barriers			
1. Comfort with figuring out how to use the LMS		Avoid learning how to do new things in LMS	"There's also things that if I know how to do it another way, I'll just do it a different way instead of trying to learn something new in Canvas."
2. Beliefs about how learning happens		Learning happens through interaction	"I believe that learning happens interactively and not in isolation."
3. Pedagogical beliefs (teaching philosophy		Explain her perspective on teaching	"I like to focus on introducing core concepts for the discipline and giving students an opportunity to apply things in their own words and with their own examples. Because I think that helps them retain the core concepts a lot better than just learning the concept in my example."

4.7 Limitations of the Study

There are several limitations in this study. Firstly, this study was limited in scope as it used non-probability sampling techniques. The results of the survey were not meant to make statistical generalizations to the entire population of faculty in U.S. higher

education. Instead, the goal of this study was to understand, explore, and gain insights on faculty use of LMS.

Secondly, the use of a modified survey from pre-existing surveys of barriers to technology integration (Chambers, 2019; Hutchison & Reinking, 2010) could have reduced the validity of the survey instrument.

Thirdly, the two non-parametric statistical tests: Mann-Whitney U tests and Kruskal-Wallis H tests were used to analyze quantitative data in this study. The disadvantages of non-parametric statistical tests are they have less statistical power compared to their equivalent parametric tests. This means there may be a lower chance of detecting a true difference if it exists between or among the groups. Besides, the data analysis results may not provide accurate answers as non-parametric statistical tests are distribution free tests.

Fourthly, when faculty answered open-ended online survey questions of why and how they used an LMS, they answered questions in phrases or a short paragraph. Due to the limited detailed descriptions received from the open-ended survey questions, it cannot be verified that their descriptions represented their detailed usages of LMS. Given this drawback, faculty's LMS uses and practices might not be accurately categorized to the PICRAT matrix.

Lastly, this study used a self-reported online survey for data collection. A self-reported survey is subject to some limitations as it relies on participants' honesty when answering questions. In addition, different participants may interpret survey questions differently. Participants might be comprised of strongly opinionated people and cause biased results.

4.8 Summary

  This study was designed to use both quantitative and qualitative data to address research questions pertaining to faculty's LMS use and barriers to technology integration. I collected data using an online survey and follow-up interviews. I conducted the online survey first, and then followed it with interviews. A total of 191 participants completed the survey. I analyzed the data from open-ended questions of the online survey using thematic analysis to identify emerging themes. I analyzed data from the 4-point Likert scale questions of the survey using both descriptive statistics and inferential statistics to report faculty's first-order and second-order barriers to technology integration. I then conducted follow-up interviews with 15 faculty members, giving in-depth insights of LMS use and barriers to technology integration. The results of this study are discussed in the next two chapters.

CHAPTER 5

RESULTS PART 1

5.1 Introduction

This chapter presents the results of the following research questions:

RQ1: Why do faculty use an LMS in U.S. higher education?

>*RQ1a:* What is the relationship between demographic factors and why
>
>faculty use an LMS in U.S. higher education?

RQ2: How do faculty use an LMS in U.S. higher education?

>*RQ2a:* What is the relationship between demographic factors and how
>
>faculty use an LMS in U.S. higher education?

The chapter begins by presenting reasons why faculty used an LMS and

discussing how this differs according to the three different LMS platforms and

demographics. Then, I present common approaches of how faculty used an LMS and

detail how this differs according to the three different LMS platforms and demographics.

I then discussed the findings and examined them through the lens of the PICRAT model.

5.2 RQ1: Why Do Faculty Use an LMS in U.S. Higher Education?

In an open-ended survey question, participants were asked to describe why they

used an LMS in the most recent semester they taught. Through a thematic analysis

(Braun & Clarke, 2006) of open-ended responses from participants, I identified a total of

12 themes. The codebook for participants' reported reasons for using an LMS are shown

in Table 10 and detailed in the following section.

Table 10

Codebook for Participants' Reported Reasons for Using an LMS

#	Theme	Description	Example quote
1.	The LMS offered/supported by my university	Participants mentioned using the LMS because it was the one provided by their university.	"Moodle is what our university uses and is supported by our tech team."
2.	University policy/required	Participants mentioned that their university had a policy or requirement of minimum use of LMS.	"It is required that we host course materials, e.g., syllabus, course assignments, etc."
3.	Host course materials	Participants mentioned they used an LMS to host course materials.	"Upload recorded lectures, distribute course materials such as lab exercises and readings."
4.	Facilitate learning activities	Participants described they hosted some type of learning activities in an LMS.	"Host discussion board threads."
5.	Host quizzes/ exams/tests	Participants mentioned they used an LMS to host or administer class quizzes, tests, or exams.	"Offer reading quizzes."
6.	Communication with students	Participants described that they communicated with students through the announcement or email features in an LMS.	"Used for communication with the class via the Announcements feature."
7.	Grading/Gradebook	Participants mentioned they used grading features in an LMS.	"Grading groupwork."
8.	Manage assignments	Participants mentioned they managed all the assignments in an LMS.	"Used for assignment dissemination and collection."
9.	Familiar with this LMS	Participants described their familiarity with the LMS they have been using.	"Previous familiarity."
10.	Used by all other faculty in the department	Participants mentioned their use of an LMS was a norm in the department.	"It was the standard already used by all other faculty in the department."
11.	Convenience	Participants mentioned using the LMS was because of the convenience.	"Convenience."
12.	Did not respond to this question	Participants did not respond to this question.	N/A

5.2.1 Common Themes in Participants' Reported Reasons for Using an LMS

A total of 191 faculty participated in the open-ended prompt and provided their comments about why they used an LMS. As an individual participant could report multiple reasons for using an LMS in each of their comments, an individual comment coded into multiple themes. All the comments generated 451 total codes. I coded each comment from a participant based on the 12 themes (see Table 10).

The most reported theme, across all participants, was *host course materials* ($n = 106$, 55%; 106 out of total 451 codes, 23.5%). This theme refers to faculty using an LMS to host course materials such as syllabi, readings, notes, links, recorded lecture videos, PowerPoint slides, supplemental materials, and resources. For example, a faculty member responded that she used Blackboard Learn to "upload recorded lectures, distribute course materials such as lab exercises and readings." Another faculty who used Moodle for "class resources… and for linking to outside resources like Padlet and Google docs," indicated that they used an LMS as a hub for sharing course materials and links.

The second most reported theme, across all participants, was *communication with students* ($n = 80$, 42%; 80 out of total 451 codes, 17.7%). This theme refers to faculty using an LMS to communicate with students through the announcements feature for mass communication or to send emails from the LMS to students. For example, one faculty member who used Blackboard Learn responded that she used it "for communication with the class via the Announcements feature." Another faculty member responded that, "I also used Moodle to email the class." These examples provide evidence that faculty used announcement or email features in an LMS for mass communication.

65

The third most reported theme, across all participants, was *university policy/required* ($n = 62$, 32%; 62 out of total 451 codes, 13.7%). This theme refers to a university having a policy or requirement of minimum use of an LMS. For example, a faculty member who used Blackboard Learn responded, "prior to the pandemic, faculty were required to post their contact information and their syllabus on Blackboard… Of course, when we went to the pandemic, we were required to use Blackboard much more extensively to post all announcements, and resources, and grading, and all that other kind of stuff," indicating that faculty followed the institution policy to use an LMS as an access point for resources and information related to the course. Another faculty who used Canvas responded, "it is required that we host course materials, e.g., syllabus, course assignments, etc. [on Canvas]." In these examples, faculty stated that they used an LMS because of the requirements from their universities.

The fourth reported theme, across all participants, was *the LMS offered/supported by my university* ($n = 50$, 26%; 50 out of total 451 codes, 11.1%). This theme refers to faculty using the LMS that was offered or supported by their universities. For example, a faculty member who used Moodle wrote, "Moodle is what our university uses and is supported by our tech team." Another faculty member who used Canvas shared, "it is the only option provided by the university," indicating that they only had the option to use the LMS that their institutions provided and supported.

The fifth reported theme, across all participants, was *manage assignments* ($n = 46$, 24%; 46 out of total 451 codes, 10.2%). This theme refers to faculty using an LMS as a tool to manage all the assignments. Faculty may post assignments for students on the LMS, collect assignments from students, and return assignments to students on the LMS.

66

For example, one faculty member used Moodle to "collect and return homework." One faculty member used Blackboard Learn "for assignment dissemination and collection." Another faculty member used Canvas to "collect course assignments." In these examples, faculty indicated that they used an LMS to administer students' assignments.

The sixth reported theme, across all participants, was *grading/Gradebook* ($n = 33$, 17%; 33 out of total 451 codes, 7.3%). This theme refers to faculty using grading features to grade students' assignments, submissions, or class activities. Faculty may also use the Gradebook feature to enter, manage, and publish grades to students. For example, one faculty member responded that she used Moodle "to inform students of grades." Another faculty member responded that she used the grading features in Canvas for "grading groupwork," using "rubrics for grading," and "student access to grades." In these examples, faculty indicated that they used grading features and made grades available for students in an LMS.

The seventh reported theme, across all participants, was *facilitate learning activities* ($n = 28$, 15%; 28 out of total 451 codes, 6.2%). This theme refers to faculty using an LMS to host some types of learning activities where students could post and share their works, such as using discussion boards/forums for class discussion or interaction. For example, one faculty used discussion forums in Moodle to host "peer-to-peer discussions and interactions." One faculty used Blackboard Learn to "host discussion board threads." One faculty used Canvas to host "asynchronous discussions." In these examples, faculty indicated that they used the discussion board feature to host discussions for student participation and interactions in an LMS.

The eighth reported theme, across all participants, was *host quizzes/exams/tests* (*n* = 21, 11%; 21 out of total 451 codes, 4.7%). This theme refers to faculty using an LMS to administer class quizzes, tests, or exams. For example, one faculty member responded that she had students "do online quizzes and exams" in Moodle. One faculty member responded that she used Blackboard Learn to "offer reading quizzes." Another faculty member responded that he used Blackboard Learn to "give tests." In these three examples, faculty shared that they used an LMS to host some types of assessments.

The ninth reported theme, across all participants, was *familiar with this LMS* (*n* = 20, 10%; 20 out of total 451 codes, 4.4%). This theme refers to faculty who used an LMS because they already have familiarity with the LMS. Faculty may be more comfortable continuing using the LMS they are used to using or the LMS where they already have their course materials set up. For example, one faculty member responded, "I have used Moodle for the entire course for many years." One faculty who used Blackboard simply reported, "previous familiarity." Another faculty who used Canvas mentioned, "I've always used it so that I don't have to set up courses every time from scratch. I migrate courses and then edit." In these examples, faculty wrote that they had been using the LMS for the courses they taught, and that; familiarity of that LMS was the reason why they used an LMS.

The tenth reported theme, across all participants, was *convenience* (*n* = 2, 1%; 2 out of total 451 codes, 0.4%). This theme refers to participants who mentioned using an LMS because of its convenience. However, with the limited descriptions from participants, it is not clear in what manner an LMS brings convenience. For example, one faculty who used Moodle simply responded, "convenience."

The eleventh reported theme, across all participants, was *used by all other faculty in the department* (*n* = 1, 0.5%; 1 out of total 451 codes, 0.2%). This theme refers to faculty using an LMS as an accepted norm as all other faculty members were also using it. For example, one faculty who used Moodle responded, "it was the standard already used by all other faculty in the department," indicating that she used Moodle because it was the LMS that was commonly used among all faculty members in her department.

Lastly, the twelfth reported theme, across all participants, was *did not respond to this question* (*n* = 2, 1%; 2 out of total 451 codes, 0.4%). This theme refers to participants who did not provide a response as to why they used an LMS. Figure 6 provides a visual representation of the percentages of all codes categorized in 12 themes by all participants.

Figure 6

Why Faculty Use an LMS, by All Participants

Why do Faculty Use an LMS by All Participants?
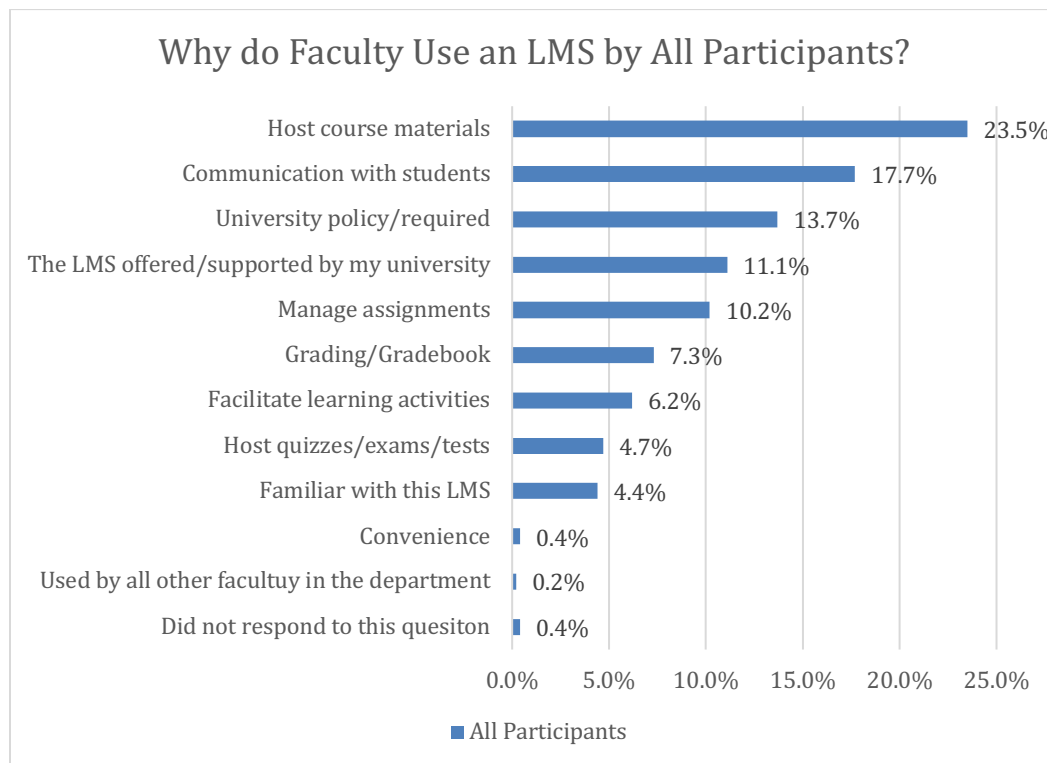
In the following section, I report faculty's three main reasons for using each LMS based on the 12 identified themes. I then provide an examination of how these reasons of using an LMS differed by the three LMS platforms: Moodle, Blackboard Learn, and Canvas.

5.2.2 The Three Most Common Themes in Each LMS Platform: Moodle, Blackboard Learn, and Canvas

When looking across all three LMS platforms (Moodle: $n = 63$; generating 157 total codes; Blackboard Learn: $n = 62$, generating 141 total codes; Canvas: $n = 66$, generating 153 total codes), there were no differences between the top two main reasons why participants reported using an LMS. The most reported reason why faculty used an LMS in the most recent semester they taught was to *host course materials* (Moodle: 22.9%, 36 out of 157 total codes; Blackboard: 23.4%, 33 out of 141 total codes; Canvas: 24.2%, 37 out of 153 total codes). For example, one faculty described using Moodle to "host course materials and links to course materials," while a faculty using Blackboard wrote, "I post materials (video, slides, hangouts)." Another faculty reported using Canvas to keep "course syllabus, modules, PowerPoint, and supplemental materials all in one place." In these examples, hosting course materials meant using the LMS as a hub for course content such as syllabi, lecture notes, recorded lecture videos, and supplemental materials.

The second most reported reason was *communication with students* (Moodle: 16.6%, 26 out of 157 total codes; Blackboard: 19.1%, 27 out of 141 total codes; Canvas: 17.6%, 27 out of 153 total codes). For example, a faculty participant described Moodle as

"one channel of communication with students," while a faculty using Blackboard shared that she "used [it] for communication with the class via the Announcements feature." Another faculty stated, "we keep all communication with students on Canvas." In these examples, faculty used the LMS as a hub for communicating with students, including using the announcements feature to send mass messages to students.

The third most reported reason why faculty used an LMS was different by LMS platforms. Faculty who used Moodle indicated that they used it to *manage assignments* for students (11.5%, 18 out of 157 total codes). For example, one professor described, "to post, collect, and give feedback on assignments." Faculty who used Blackboard reported that they used it because of *university policy/required* (16.3%, 23 out of total 141 total codes). For example, one professor reported, "I use the LMS per university policy." Canvas faculty users indicated that they used it because it is *the LMS offered/supported by my university* (15%, 23 out of total 153 codes). For example, one professor wrote, "it is the LMS supported by my institution."

While there were some differences in the most common reasons for using each LMS by themes, across the data set, faculty seemed most likely to use a LMS as a hub to curate course materials and to communicate with students by posting announcements and because they were required to. Figure 7 provides a visual representation of percentages of all codes categorized in 12 themes by three LMS platforms.

Figure 7

Why Faculty Use an LMS

Why do Faculty Use an LMS in the Most Recent Semester They Taught by Three LMS Platforms?

Theme	Moodle	Blackboard	Canvas
Host course materials	22.9%	23.4%	24%
Communication with students	16.6%	19.1%	17.6%
University policy/required	10.8%	16.3%	14.4%
The LMS offered/supported by my university	7%	11.3%	15%
Manage assignments	11.5%	7.8%	11.1%
Grading/Gradebook	10.8%	3.5%	7.2%
Facilitate learning activities	5.1%	5.7%	7.8%
Host quizzes/exams/tests	5.7%	7.8%	0.7%
Familiar with this LMS	8.3%	3.5%	1.3%
Convenience	0.6%	0.7%	0%
Used by all other faculty in the department	0.6%	0.0%	0%
Did not respond to this question	0%	0.7%	0.7%

■ Moodle ■ Blackboard ■ Canvas

5.2.3 The Three Least Common Themes in Each LMS Platforms: Moodle, Blackboard Learn, and Canvas

Overall, the three least reported themes out of the total 12 identified themes across all the three different LMS platforms were: *convenience* (Moodle: 0.6%, 1 out of total 157 codes; Blackboard: 0.7%, 1 out of total 141 codes; Canvas: 0%, 0 out of total 153

72

codes), *used by all other faculty in the department* (Moodle: 0.6%, 1 out of total 157

codes; Blackboard: 0%, 0 out of total 141 codes; Canvas: 0%, 0 out of total 153 codes),

and *did not respond to this question* (Moodle: 0%, 0 out of total 157 codes; Blackboard:

0.7%, 1 out of total 141 codes; Canvas: 0.7%, 1 out of total 153 codes). Excluding one of

the least reported themes, *did not respond to this question*, the findings indicated that

faculty rarely thought *convenience* and an LMS *was used by all other faculty in the*

department were the main reasons to influence their use of an LMS.

When looking at the other nine commonly reported themes (out of the 12

identified ones) based on the three LMS platforms (see Figure 2), faculty who used

Moodle indicated that *facilitate learning activities* was one of the least reported reasons

for using LMS (5.1%, 8 out of total 157 codes). For instance, one faculty simply reported

that she used "discussion forums," while another faculty shared how she used discussion

forums in the follow-up interview:

> To be perfectly honest, the discussion, it's just… I think it's, they call it… In
>
> Moodle, they have their own terminology, so they call it like discussion forum. In
>
> fact, I don't quite use it as a forum. I use it as just like Q&A. I post a prompt and
>
> the requirements, like how many words, which subjects. And then, each student
>
> responds, and they can read each other's. That's what I do.

In this example, the faculty shared how she used the discussion forums to only post

assignments, indicating that the discussion activities for students through the discussion

forum was limited.

Faculty who used Blackboard indicated that *grading/Gradebook* (3.5%, 5 out of total 141 codes) and *familiar with this LMS* (3.5%, 5 out of total 141 codes) were both the least reported reasons for using an LMS. For instance, one faculty responded that she used Blackboard for "grade management." Another faculty shared, "I have been using it for years as part of teaching online with the Continuing Ed Program," indicating his familiarity with Blackboard.

Faculty who used Canvas indicated that *host quizzes/exams/tests* (0.7%, 1 out of total 153 codes) was the least reported reason for using an LMS. For instance, only one faculty reported, "hold online quizzes and exams," indicating that faculty who used Canvas were rarely thinking of hosting quizzes or exams as the main reasons to support their LMS use.

The findings from this data set show that faculty did not report *facilitate learning activities* as one of their main reasons to use an LMS across all the three LMS platforms (Moodle: 5.1%, 8 out of total 157 codes; Blackboard: 5.7%, 8 out of total 141 codes; Canvas: 7.8%, 12 out of total 153 codes). These findings indicated that faculty were more likely to use an LMS as a hub to curate course materials and to communicate with students by posting announcements or sending mass emails rather than to design and facilitate learning activities in an LMS.

5.3 RQ1a: What Is the Relationship Between Demographic Factors and Why Faculty Use an LMS in U.S. Higher Education?

In the following section, I report faculty's main reasons for using an LMS based on the 12 identified themes as differentiated by five demographic factors: 1) gender, 2)

age, 3) years of teaching experience, 4) years of using digital tools, and 5) years of using an LMS.

5.3.1 Gender

When looking at the gender of participants (female: $n = 125$, generating 301 total codes; male: $n = 66$, generating 150 total codes), there were not any differences between faculty who identified as female and faculty who identified as male in the three main reasons why they used an LMS. The most common reason across both genders was to *host course materials* (female: 23.3%, 70 out of total 301 codes; male: 24%, 36 out of total 150 codes). For instance, a female professor who used Canvas wrote "I used it to post the syllabus, weekly schedule… videos," while a male professor reported using Canvas to "post lecture notes and recorded lecture videos." In these examples, hosting course materials meant using the LMS as a hub for course content such as syllabi, lecture notes, and recorded lecture videos.

The second most reported reason was *communication with students* (female: 18.6%, 56 out of total 301 codes; male: 16%, 24 out of total 150 codes). For example, a female professor shared that she used Moodle "for communication with the class via the Announcements feature," while a male professor reported that he used Canvas to "email students." In these examples, communication with students meant using the email or announcements features to send mass messages to students in the LMS.

The third most reported reason was *university policy/required* (female: 14.6%, 44 out of total 301 codes; male: 12%, 18 out of total 150 codes). For instance, one female professor wrote, "Canvas is the LMS chosen by our university, and it is required that we

host course materials." Another female professor who used Blackboard wrote, "Policy; all online courses use it." One male professor who used Moodle reported, "university policy required for Gradebook." In these examples, faculty members demonstrated that their use of an LMS follows their university policy/requirement.

Both female faculty and male faculty did not report *facilitate learning activities* as one of the three main reasons for using an LMS (female: 6%, 18 out of total 301 codes; male: 6.7%, 10 out of total 150 total codes). Figure 8 provides a visual representation of the percentages of all codes categorized in 12 themes by gender.

Figure 8

Why Faculty Use an LMS, by Gender

Why do Faculty Use an LMS in the Most Recent Semester They Taught by Gender?

Category	Female	Male
Host course materials	23.3%	24%
Communication with students	18.6%	16%
University policy/required	14.6%	12%
The LMS offered/supported by my…	11%	11.3%
Manage assignments	11.3%	8%
Grading/Gradebook	7%	8%
Facilitate learning activities	6%	6.7%
Host quizzes/exams/tests	4.3%	5.3%
Familiar with this LMS	3%	7.3%
Convenience	0%	1.3%
Used by all other facultuy in the…	0.3%	0%
Did not respond to this quesiton	0.7%	0%

Overall, there was no substantial difference as to why faculty used an LMS when looking at the data based on gender. Both female and male faculty reported the same three main reasons for using an LMS: *host course materials*, *communication with students*, and *university policy/required*. These findings indicated that other than following university policy as a reason to use an LMS, female and male faculty were more likely to use an LMS as a hub to host course materials and to communicate with students by posting announcements or sending mass emails rather than to design activities and facilitate learning in an LMS.

5.3.2 Age

When looking at the themes based on the three different age groups of faculty members (≤ 40 years old: $n = 71$, 161 total codes; 41–49 years old: $n = 60$, 148 total codes; ≥ 50 years old: $n = 60$, 142 total codes), there were no differences among the two main reasons for using an LMS across the three different age groups. The most reported reason why faculty used an LMS was to *host course materials* (≤ 40 years old: 27.3%, 44 out of total 161 codes; 41–49 years old: 19.6%, 29 out of total 148 codes; ≥ 50 years old: 23.2%, 33 out of total 142 codes). For instance, a faculty aged 40 years or younger described, "I used it to post lecture checklist, and host course materials," while a professor aged 41 to 49 years reported, "host course materials, provide links to relevant academic department material." Another professor aged 50 years or older wrote, "provided access to course materials, including links to videos and synchronous Zoom link." In these examples, faculty described why they used an LMS as a platform to provide all course materials and relevant resources.

The second most reported reason for faculty members to use an LMS was *communication with students* (≤ 40 years old: 18%, 29 out of total 161 codes; 41–49 years old: 16.9%, 25 out of total 148 codes; ≥ 50 years old: 18.3%, 26 out of total 142 codes). For example, a faculty aged 40 years or younger reported, "post/send announcements to students," while a professor aged 41 to 49 years described, "communications with students—weekly announcements." A faculty aged 50 years or older reported, "used for communication with the class via the Announcements feature." In these examples, faculty across all the three age groups tended to communicate with students through using the announcement feature in the LMS to send mass information.

The third most reported reason why faculty members used an LMS varied among age groups. *University policy/required* was the third most reported reason reported by faculty younger than 40 years old and faculty aged 41 to 49 years (≤ 40 years old: 16.8%, 27 out of total 161 codes; 41–49 years old: 13.5%, 20 out of total 148 codes). For example, one professor aged 40 years or younger reported, "college policy," while another described, "it is required that we host course materials (e.g., syllabus, course assignments, etc.)." A professor aged 41 to 49 years reported, "mandated by the university." In these examples, faculty showed that their LMS use was based on the requirements or policy from their institutions.

There was a tie for the third most reported reasons for faculty aged 50 years and older: *the LMS offered/supported by my university* (12%, 17 out of total 142 codes) and *manage assignments* (12%, 17 out of total 142 codes). For instance, one faculty aged 50 years or older wrote, "Moodle is what our university uses and is supported by our tech team," while another commented, "I used Blackboard, because that was the one my

78

institution has." In these examples, faculty members showed that they tended to use the LMS that their institutions provided and supported. In terms of using the LMS to *manage assignments*, one faculty aged 50 years or older reported that she used Blackboard to "accept and return assignments," while another shared, "I always use my LMS to collect student assignments." In these examples, faculty members tended to use an LMS for assignment management. Figure 9 provides a visual representation of percentages of all codes categorized in 12 themes by age groups.

Figure 9

Why Faculty Use an LMS, by Age
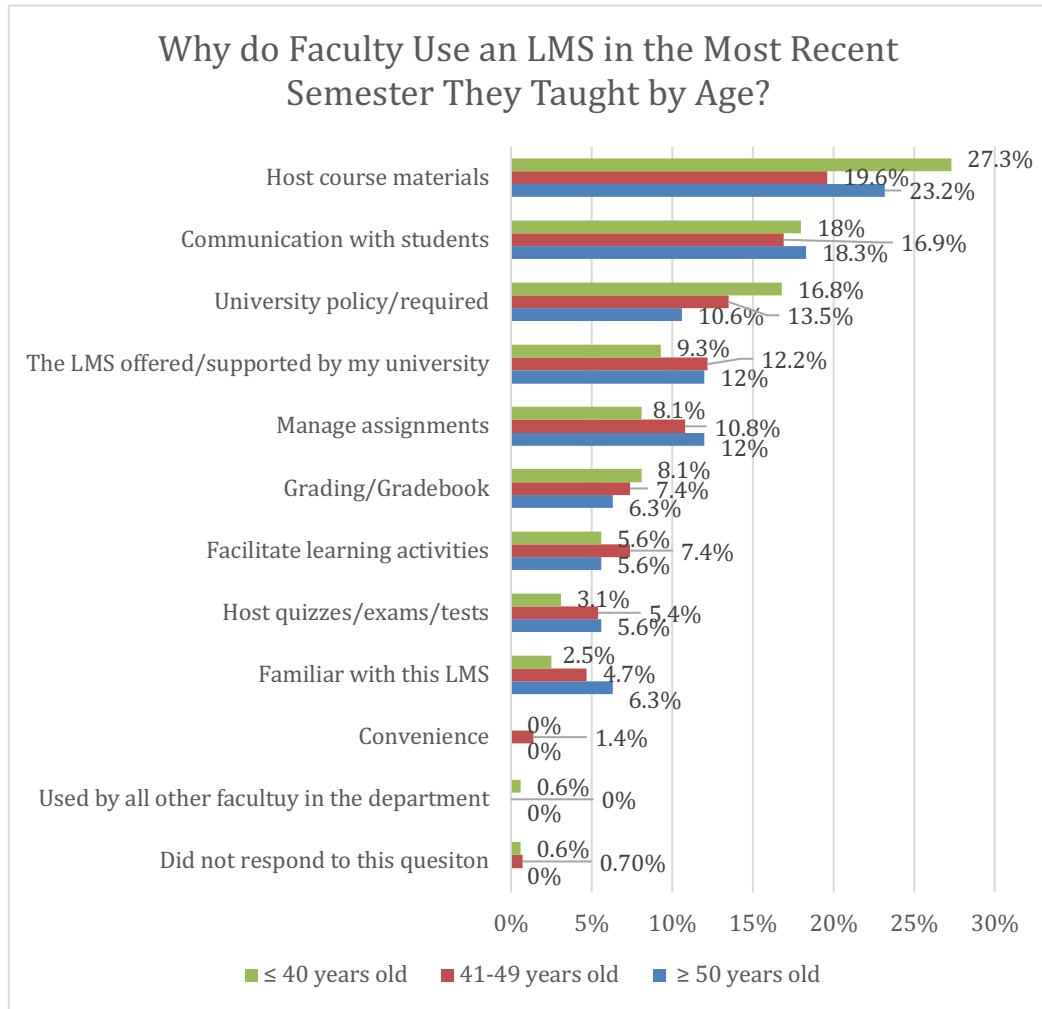
Overall, the findings showed that faculty tended to use an LMS to *host course materials*, as this is the most reported reason across the three age groups. The findings in this data set showed that *facilitate learning activates* was not one of the main reported reasons why faculty used an LMS across all the three age groups ($\leq$ 40 years old: 5.6%, 9 out of total 161 codes; 41–49 years old: 7.4%, 11 out of total 148 codes; $\geq$ 50 years old: 5.6%, 8 out of total 142 codes). These findings indicated that faculty across all the age groups were more likely to use an LMS as a hub to curate course materials and to communicate with students by posting announcements or sending mass emails rather than to design activities and facilitate learning in an LMS. While faculty who were younger than 50 years old tended to follow the university policy or requirements to use an LMS, faculty members aged 50 years or older seemed to indicate that *university policy/required* was not the main reasons why they used an LMS. Instead, faculty members aged 50 years or older indicated that they were more likely to choose to use an LMS already offered and supported by their institutions. The findings also show that faculty members aged 50 years or older tended to use an LMS to manage student assignments, while faculty younger than 50 years old did not address this as one of their three main reasons for using an LMS.

5.3.3 Years of Teaching Experience

When looking at the themes based on the three different groups of faculty's teaching experience ($\leq$ 10 years: $n = 76$, generating 161 total codes; 11–20 years: $n = 58$, generating 154 total codes; 20+ years: $n = 56$, generating 135 total codes), there was no difference in the most reported reason why they used an LMS across the three groups.

80

The most reported reason why faculty used an LMS was to *host course materials* (≤10 years: 24.8%, 40 out of total 161 codes; 11–20 years: 22.7%, 35 out of total 154 codes; 20+ years: 23%, 31 out of total 135 codes). For example, a faculty with 10 or less years of teaching experience reported, "I used it to serve as the course website, a hub for course content," while a faculty with 11 to 20 years of teaching experience described, "host course materials (notes, links to video tutorials)." A faculty with more than 20 years of teaching experience reported, "posting material including video lectures." In these examples, faculty reported using an LMS as a platform to provide course materials and resources.

The second most reported reason for faculty using an LMS was different among the three groups. *University policy/required* was the second most commonly reported reason for faculty with 10 or less years of teaching experience (18.6%, 30 out of total 161 codes), while *communication with students* was the second most commonly reported reason for faculty who had taught 11 to 20 years (18.8%, 19 out of total 154 codes) and faculty who had taught over 20 years (17%, 23 out of total 135 codes). For example, one faculty with 10 or less years of teaching experience described, "the university dictates that I use their Moodle-based LMS platform for those courses." One faculty who had taught 11 to 20 years reported that he used an LMS as a "central communication point," while another faculty who had taught over 20 years reported, "communication with entire class." In these examples, faculty with less teaching experience tended to follow the policy from their institutions to use an LMS, while faculty with more teaching experience (more than 10 years) were more likely to use an LMS as a platform to communicate with students.

The third most reported reason for faculty using LMS was different across the three groups of teaching experience. *Communication with students* was the third main reason for faculty with 10 or less years of teaching experience (17.4%, 28 out of total 161 codes). For example, one faculty reported, "mass communication with students." *Manage assignments* was the third most reported reason to use an LMS for faculty with 11 to 20 years of teaching experience (13%, 20 out of total 154 codes). For example, one faculty described she used the LMS for "students upload assignments." *University policy/required* (12.6%, 17 out of total 135 codes) and *the LMS offered/supported by my university* (12.6%, 17 out of total 135 codes) were reported as the third most reported reason to use an LMS by faculty who had over 20 years teaching experience. For example, one faculty reported, "university policy required for Gradebook," while another wrote, "it is the supported system in my college." In these examples, faculty with over 20 years teaching experience described that their use of LMS was due to the policy or the only system supported in their institutions. Figure 10 provides a visual representation of the percentages of all codes categorized in 12 themes by teaching experience.

Figure 10

Why Faculty Use an LMS, by Teaching Experience

Why do Faculty Use an LMS in the Most Recent Semester They Taught by Teaching Experience?

Category	≤ 10 years	11-20 years	20+ years
Host course materials	24.8%	22.7%	22.8%
Communication with students	17.4%	18.8%	16.9%
University policy/required	18.6%	9.7%	12.5%
The LMS offered/supported by my university	11%	10.4%	12.5%
Manage assignments	8.1%	13%	9.6%
Grading/Gradebook	6.2%	9.1%	6.6%
Facilitate learning activities	5%	7.1%	6.6%
Host quizzes/exams/tests	3.1%	5%	5.9%
Familiar with this LMS	4.3%	3.2%	5.9%
Convenience	0.6%	0%	0.7%
Used by all other facultuy in the department	0.6%	0%	0%
Did not respond to this quesiton	0.6%	0.6%	0%

Legend:
- Teaching Experience: ≤ 10 years
- Teaching Experience: 11-20 years
- Teaching Experience: 20+ years

Overall, the findings showed that faculty tended to use an LMS to host course materials, as this was the most reported reason across the three groups of teaching experience. The findings in this data set indicated that *facilitate learning activities* was not one of the main reported reasons why faculty used an LMS across all the three groups of teaching experience (≤10 years: 5%, 8 out of total 161 codes; 11–20 years: 7.1%, 11 out of total 154 codes; 20+ years: 6.7%, 9 out of total 135 codes), suggesting that faculty were more likely to use an LMS as a hub to curate course materials rather than to design activities and facilitate learning in the LMS, no matter their teaching experience. The findings indicated that teaching experience might influence faculty's second main reason for using an LMS, as the results showed that faculty with more than 10 years of teaching experience (11–20 years and 20+ years) tended to use an LMS for *communication with students*, while faculty with 10 or fewer years of teaching experience were more likely to follow university policy to use an LMS. This was different from the findings in the previous section about age groups, as faculty across all three age groups reported *communication with students* as the second most reported reason why they used an LMS.

5.3.4 Years of Using Digital Tools

When looking at the themes based on the five different groups of faculty members' experience using digital tools, there was no difference in the most commonly reported reason why faculty used an LMS (≤ 5 years: $n = 42$, generating 78 total codes; 6–10 years: $n = 43$, generating total 112 codes; 11–15 years: $n = 44$, generating 119 total codes; 16–20 years: $n = 33$, generating total 77 codes; 20+ years: $n = 29$, generating 65 total codes). The most reported reason across the five groups was to *host course*

materials (≤ 5 years: 26.9%, 21 out of total 78 codes; 6–10 years: 24.1%, 27 out of total

112 codes; 11–15 years: 23.5%, 28 out of total 119 codes; 16–20 years: 19.5%,15 out of

total 77 codes; 20+ years: 23.1%, 15 out of total 65 codes). For example, one faculty with

5 year or less of using digital tools experience reported that he used an LMS to "post

lecture notes and recorded lecture videos," while another faculty with 6 to 10 years of

using digital tools experience described, "host course materials, post all readings." One

faculty with 11 to 15 years of using digital tools experience reported, "share course

materials." Another faculty with 16 to 20 years of using digital tools experience

described, "upload recorded lectures, distribute course materials such as lab exercise and

readings," while the other faculty with more than 20 years of using digital tools

experience reported, "posting material including video lecture." In these examples,

faculty across all different groups of using digital tools experience indicated that they

used an LMS as a hub to host course materials and resources.

The second most reported reason for using an LMS, *university policy/required*,

was indicated by faculty with 5 or less years of using digital tools for teaching (20.5%, 16

out of 78 total codes), while *communication with students* was the second most reported

reason for the rest of faculty in the other four groups of using digital tools for teaching

(6–10 years: 17.9%, 20 out of total 112 codes; 11–15 years: 18.5%, 22 out of total 119

codes; 16–20 years: 16.9 %, 13 out of total 77 codes; 20+ years: 16.9%, 11 out of total 65

counts). For example, one faculty with 5 or less years of using digital tools for teaching

described that she used the LMS because of "university policy" even though she followed

that with "I hate Moodle very much," indicating that the only reason she used the LMS

was because it was required. One faculty with 6 to 10 years of using digital tools reported

that she would "post/send announcements to students," while one faculty with 11 to 15 years of using digital tools for teaching reported that she used an LMS to "send announcement and information." One faculty with 16 to 20 years of using digital tools described, "Moodle is a good way for me to communicate with students," while another faculty with over 20 years of using digital tools for teaching reported that she used an LMS to post "announcements for students." In these examples, faculty with less experience using digital tools for teaching (5 or less years) seemed more likely to use an LMS due to a university mandate, while faculty with more experience using digital tools for teaching (6 to 20+ years) tended to use the announcement feature in the LMS to send mass messages to communicate with students.

The third most reported reason for using an LMS was different among faculty members in the five different groups of using digital tools for teaching. *Communication with students* was the third most reported reason for faculty with 5 or less years of using digital tools for teaching (17.9%, 14 out of total 78 codes). For example, one faculty reported, "I also used Moodle to email the class." *University policy/required* was the third most reported reason for faculty with 6 to 10 years of using digital tools for teaching (17%, 19 out of 112 total codes). For example, one faculty described, "departmental and university policy require use of Moodle for this course." *The LMS offered/supported by my university* (12.6%, 15 out of total 119 codes) and *manage assignments* (12.6%, 15 out of total 119 codes) were the third most reported reasons for faculty with 11 to 15 years of using digital tools for teaching. For example, one faculty reported, "This is what is available and supported by the college system," while another described, "used for assignment dissemination and collection." In these examples, faculty with 11 to 15 years

86

of using digital tools for teaching shared they used the LMS because of its availability and for managing student assignments. *Manage assignments* was also the third most reported reason for faculty with 16 to 20 years of using digital tools for teaching (11.7%, 9 out of 77 counts). For example, one faculty described that he used Canvas "to collect certain kinds of assignments from them [students]," indicating that he used the LMS as a management tool for student assignments. *The LMS offered/supported by my university* (15.4%, 10 out of total 65 codes) was the third most reported reason for faculty with over 20 years of using digital tools for teaching. For example, one faculty described, "I used Blackboard because that was the one my institution has," indicating that faculty used the only option provided in his university. The quotes above demonstrated the faculty's third most reported reasons for using an LMS: *communication with students*, *university policy/required*, *the LMS offered/supported by my university*, and *manage assignments*. Figure 11 provides a visual representation of the percentages of all codes categorized in 12 themes by years of using digital tools for teaching groups.

Figure 11

Why Faculty Use an LMS, by Years of Using Digital Tools

Why do Faculty Use an LMS in the Most Recent Semester They Taught by Years of Using Digital Tools?

Host course materials
- 26.9%
- 24.1%
- 23.5%
- 19.5%
- 23.1%

Communication with students
- 17.9%
- 17.9%
- 18.5%
- 16.9%
- 16.9%

University policy/required
- 20.5%
- 17%
- 10.1%
- 10.4%
- 10.8%

The LMS offered/supported by my university
- 9%
- 8.9%
- 12.6%
- 10.4%
- 15.4%

Manage assignments
- 9%
- 8%
- 11.8%
- 11.7%
- 10.8%

Grading/Gradebook
- 6.4%
- 8.9%
- 6.7%
- 7.8%
- 6.2%

Facilitate learning activities
- 0%
- 8.9%
- 7.6%
- 6.5%
- 6.2%

Host quizzes/exams/tests
- 3.8%
- 2.7%
- 6.7%
- 6.5%
- 3.1%

Familiar with this LMS
- 3.8%
- 3.6%
- 1.7%
- 10.4%
- 4.6%

Convenience
- 1.3%
- 0%
- 0%
- 0%
- 1.5%

Used by all other facultuy in the department
- 0%
- 0%
- 0.8%
- 0%
- 0%

Did not respond to this quesiton
- 1.3%
- 0%
- 0%
- 0%
- 1.5%

Legend:
- Years of using digital tool: ≤5 years
- Years of using digital tool: 6-10 years
- Years of using digital tool: 11-15 years
- Years of using digital tool: 16-20 years
- Years of using digital tool: 20+ years

The findings showed that *host course materials* was the faculty's main reason for using an LMS. The findings in this data set indicated that *facilitate learning activates* was not one of the main reported reasons why faculty used an LMS across all the five groups of experience using digital tools for teaching ($\leq$ 5 years: 0%, 0 out of total 78 codes; 6–10 years: 8.9%, 10 out of total 112 codes; 11–15 years: 7.6%, 9 out of total 119 codes; 16–20 years: 6.5%, 5 out of total 77 codes; 20+ years: 6.2%, 4 out of total 65 codes). In fact, faculty with 5 or less years of using digital tools for teaching did not even report *facilitate learning activities* as one of the reasons to use an LMS; instead, they were more likely to follow university policy to use an LMS (the second main reason) compared to the other four groups of faculty members. These findings indicated that faculty were more likely to use an LMS as a hub to curate course materials rather than to design activities and facilitate learning in an LMS, no matter their experience using digital tools for teaching.

The findings also indicated that *communication with students* was one of the three most reported reasons for using an LMS across all the five groups of experience using digital tools. Faculty with less experience using digital tools for teaching (10 or less years) tended to report *university policy/required* as one of the three most common reasons why they used an LMS, while faculty with over 10 years' experience using digital tools for teaching did not indicate this.

5.3.5 Years of Using an LMS

When looking at the themes based on the years of experience using an LMS ($\leq$ 3 years: *n* = 49, generating 89 total codes; 4–6 years: *n* = 54, generating total 145 codes; 7–9 years: *n* = 39, generating 86 total codes; $\geq$10 years: *n* = 49, generating total 131 codes),

there was no difference in the most common reason why faculty used an LMS in the most recent semester they taught. The most reported reason across the four groups of faculty members was to *host course materials* (≤ 3 years: 24.7%, 22 out of total 89 codes; 4–6 years: 25.5%, 37 out of total 145 codes; 7–9 years: 23.3%, 20 out of total 86 codes; ≥ 10 years: 20.6%, 27 out of total 131 codes). For example, one faculty with 3 or less years of using Canvas reported, "host required and supplementary course materials," while another faculty with 4 to 6 years of using an LMS described, "link to pre-recorded lectures, class material, everything was posted on Moodle." One faculty with 7 to 9 years of using an LMS reported, "host course materials, class recordings, links to Zoom, etc.," while another faculty with 10 or more years of using an LMS described, "provided access to course materials including links to videos and synchronous Zoom link." In these examples, faculty across all four groups of years of experience using an LMS showed that their priority use of an LMS was to curate courses materials and resources.

The second most common reason for using an LMS was different by faculty members' experience using an LMS for teaching. *University policy/required* was the second most reported reason for faculty with 3 or less years' experience using LMS for teaching (22.5%, 20 out of total 89 codes). For example, one faculty described, "required by university," indicating that she followed institution policy to use an LMS. *Communication with students* was the second most reported reason for the other three groups of faculty members (4–6 years: 20%, 29 out of total 145 total codes; 7–9 years: 17.4%, 15 out of total 86 codes; ≥ 10 years: 16%, 21 out of total 131 codes). For examples, one faculty with 4 to 6 years' experience using an LMS described, "we keep all communication with students on Canvas," while another faculty with 7 to 9 years' of

using an LMS reported, "convenient communication with students." One faculty with 10 or more years' experience using an LMS described that she would "send announcement and information" for communicating with students. In these examples, faculty shared that they used an LMS as a platform for communicating with students.

The third most reported reason for using an LMS varied by faculty' experience using LMS for teaching. *Communication with students* (16.9%, 15 out of total 89 codes) was the third most reported reason for faculty with 3 or less years' experience using an LMS for teaching. For example, one faculty wrote she used Canvas to "maintain communication with students." In the follow-up interview, she shared the features in Canvas that she used to communicate with students:

> The biggest thing is I use announcements for them. So, I have been posting a lot. I have more postings I need to do today. For my announcements, I just leave that as my announcements to them. So, I don't have any responses directly from students to these. And I do that mostly just to keep my communication with them, their communication with me in one space. Then, I also use the mail feature a lot. I mean, I have four in red, but I typically see them in my email inbox before my Canvas inbox. I'll just respond that way. But those are kind of the big ones that I use.

In this example, the faculty indicated that she maintained her communication with students by using the announcements feature for postings and email feature for replying to students' messages.

University policy/required was the third most reported reason for faculty with 4–6 years and 7–9 years of using an LMS for teaching (4–6 years: 13.1%, 19 out of total 145 codes; 7–9 years: 11.6%, 10 out of total 86 codes). For example, one faculty with 4 to 6 years of using an LMS for teaching shared, "Canvas is the LMS chosen by our university, and it is required that we host course materials (e.g., syllabus, course assignments, etc.)," while another faculty with 7 to 9 years of using an LMS for teaching reported, "mandated LMS by [my school]." These examples indicated that faculty followed institutions' policies to use an LMS. *The LMS offered/supported by my university* (13%, 17 out of total 131 codes) was the third most reported reason for faculty had 10 or more years' experience using LMS for teaching. For example, one faculty described, "it is the supported system at my college," indicating that faculty used the LMS that was available and supported by her institution. Through the quotes presented above, faculty showed their third most reported reasons for using an LMS were varied: *communication with students*, *university policy/required*, and *the LMS offered/supported by my university*. Figure 12 provides a visual representation of the percentages of all codes categorized in 12 themes by faculty members' years of experience using an LMS.

Figure 12

Faculty Use of LMS, by Years of Using an LMS

Why do Faculty Use an LMS in the Most Recent Semester They Taught by Years of Using LMS?

Host course materials
- 24.7%
- 25.5%
- 23.3%
- 20.6%

Communication with students
- 16.9%
- 20%
- 17.4%
- 16%

University policy/required
- 22.5%
- 13.1%
- 11.6%
- 9.9%

The LMS offered/supported by my university
- 13.5%
- 8.3%
- 10.5%
- 13%

Manage assignments
- 10.1%
- 11.7%
- 8.1%
- 9.9%

Grading/Gradebook
- 3.4%
- 9.7%
- 8.1%
- 6.9%

Facilitate learning activities
- 3.4%
- 4.8%
- 8.1%
- 8.4%

Host quizzes/exams/tests
- 0%
- 4.1%
- 3.5%
- 9.2%

Familiar with this LMS
- 2.2%
- 2.8%
- 8.1%
- 5.3%

Convenience
- 0%
- 0%
- 1%
- 0.8%

Used by all other facultuy in the department
- 1.1%
- 0%
- 0%
- 0%

Did not respond to this quesiton
- 2.2%
- 0%
- 0%
- 0%

Legend:
- ■ Years of using LMS: ≤3 years
- ■ Years of using LMS: 4-6 years
- ■ Years of using LMS: 7-9 years
- ■ Years of using LMS: ≥ 10 years

Overall, faculty tended to use an LMS to *host course materials*, as this was the most reported reason across the four groups of experience using an LMS for teaching. The findings in this data set indicated that *facilitate learning activates* was not one of the three main reported reasons why faculty used an LMS across all four groups of experience using an LMS for teaching (≤ 3 years: 3.4%, 3 out of total 89 codes; 4–6 years: 4.8%, 7 out total 145 codes; 7–9 years: 8.1%, 7 out of total 86 codes; ≥ 10 years: 8.4%, 11 out of total 131 codes). Faculty were more likely to use an LMS as a hub to curate course materials, to communicate with students by posting announcements, or to send mass emails rather than to design activities and facilitate learning in an LMS. The findings also showed that faculty with less years of experience using an LMS for teaching (3 or less years of using an LMS for teaching) were more likely to follow *university policy* to use an LMS (≤ 3 years: 22.5%, 20 out of total 89 codes), while the other three groups of faculty members reported that their second common reason for using an LMS was to *communicate with students* (4–6 years: 20%, 29 out of total 145 codes; 7–9 years: 17.4%, 15 out of total 86 codes; ≥ 10 years: 16%, 21 out of total 131 codes).

5.4 Examining Why Faculty Use an LMS Through the Lens of the PICRAT Model

In this section, I first summarize faculty's main reasons for using an LMS through the analysis of participants' responses to the open-ended prompt. I broke the summary of responses down into six groups: 1) the three LMS platforms, 2) gender, 3) age, 4) years of teaching experience, 5) years of using digital tools, and 6) years of using an LMS. After this summary, I examine faculty's main reasons for using an LMS by mapping the

responses to the PICRAT matrix. Table 11 presents the summary of the main reasons why faculty use an LMS across the six groups.

Table 11

Summary of the Results – Why Faculty Use an LMS

Group	Subgroup	Why do Faculty Use an LMS?		
		First main reason	Second main reason	Third main reason
LMS platforms	Moodle	host course materials	communication with students	manage assignments
	Blackboard	host course materials	communication with students	university policy/required
	Canvas	host course materials	communication with students	the LMS offered/supported by my university

Demographic

Group	Subgroup	First main reason	Second main reason	Third main reason
Gender	Man	host course materials	communication with students	university policy/required
	Woman	host course materials	communication with students	university policy/required
Age	≤ 40	host course materials	communication with students	university policy/required
	41–49	host course materials	communication with students	university policy/required
	≥ 50	host course materials	communication with students	the LMS offered/supported by my university manage assignments

Years of Teaching experience	1–10	host course materials	university policy/required	communication with students
	11–20	host course materials	communication with students	manage assignments
	20 +	host course materials	communication with students	university policy/required the LMS offered/supported by my university
Years of using digital tools	≤5	host course materials	university policy/required	communication with students
	6–10	host course materials	communication with students	university policy/required
	11–15	host course materials	communication with students	the LMS offered/supported by my university manage assignments
	16–20	host course materials	communication with students	manage assignments
	20 +	host course materials	communication with students	the LMS offered/supported by my university
Years of using LMS	≤ 3	host course materials	university policy/required	communication with students
	4–6	host course materials	communication with students	university policy/required
	7–9	host course materials	communication with students	university policy/required

≥ 10	host course materials	communication with students	the LMS offered/supported by my university

Overall, faculty across the six groups reported why they used an LMS for the

following main reasons: 1) *host course materials*, 2) *communication with students*, 3)

manage assignments, 4) *university policy/required*, and 5) *the LMS offered/supported by*

my university. From these five main reported reasons, three reasons addressed the use of

an LMS: *host course materials*, *communication with students*, and *manage assignments*.

The other two described the university policy and university support regarding the LMS.

I mapped the three main reasons for why faculty used an LMS to the PICRAT

matrix—1) *host course materials*, 2) *communication with students*, 3) *manage*

assignments—as these reasons addressed the use of an LMS. The evaluation method of

mapping the reasons to the PICRAT matrix was as follows: to determine the PIC part of

the matrix, I examined the reasons why faculty used an LMS to determine if the activity

was Passive, Interactive, or Creative. Kimmons et al. (2020) defined the Passive level as

"students passively observe or listen to rather than engaging with as active participants"

(p.185), the Interactive level as "students are directly interacting with the technology (or

with other learners through the technology), and their learning is mediated by that

interaction" (p.185), and the Creative level as "having students use the technology as a

platform to construct learning artifacts that instantiate learning mastery" (p.186). To

determine the RAT part of the matrix, I examined the reasons why faculty used an LMS

by applying the flowchart in Figure 13. First, I asked if faculty's use of LMS was simply

a replacement of traditional practice or if it improved learning. If the use of an LMS

improved learning, then I determined whether it could have been done via a lower tech

solution. If the answer was "Yes," the use of an LMS amplified traditional practice, while

if the answer was "No," the use of an LMS was a transformation.

Figure 13

Flowchart for Determining RAT
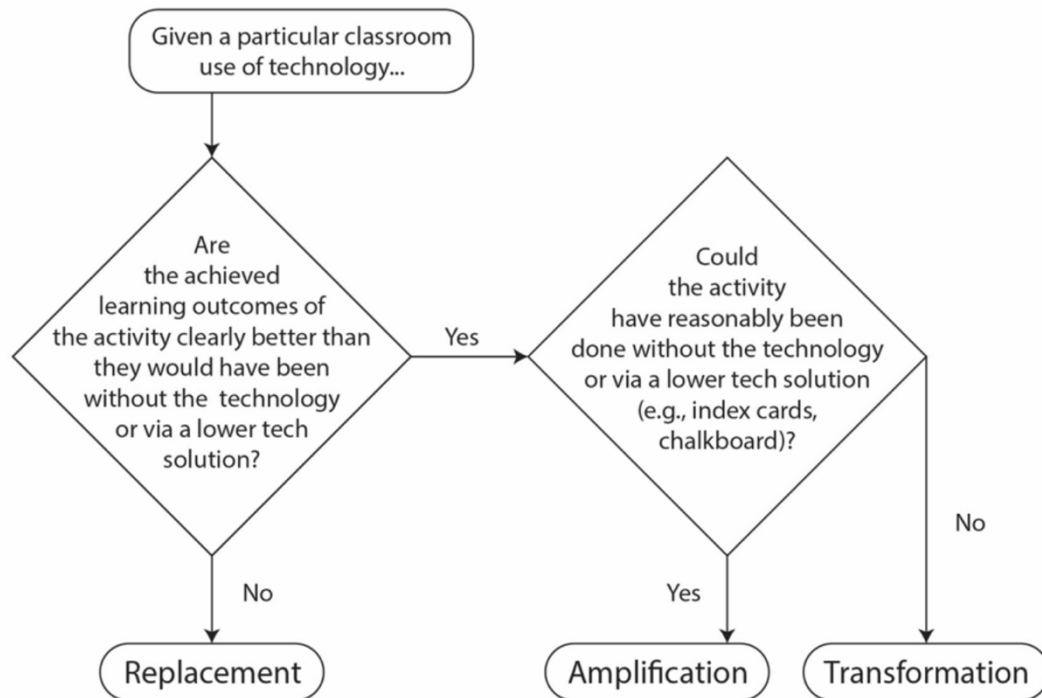
Note. The flowchart for determining RAT in PICRAT matrix. From "The PICRAT Model for Technology Integration in Teacher Preparation," by R. Kimmons, C.R. Graham, & R.E. West, 2020, *Contemporary Issues in Technology and Teacher Education, 20(1)*. (https://citejournal.org/volume-20/issue-1-20/general/the-picrat-model-for-technology-integration-in-teacher-preparation). CC BY-NC 4.0.

Using this evaluation method, I determined where faculty's reasons for using an LMS were on the PICRAT matrix. Figure 14 provides a visual presentation categorizing the main reasons of using an LMS within a PICRAT matrix.

Figure 14

Faculty's Main Reasons Why Using an LMS Mapped to the PICRAT Matrix.
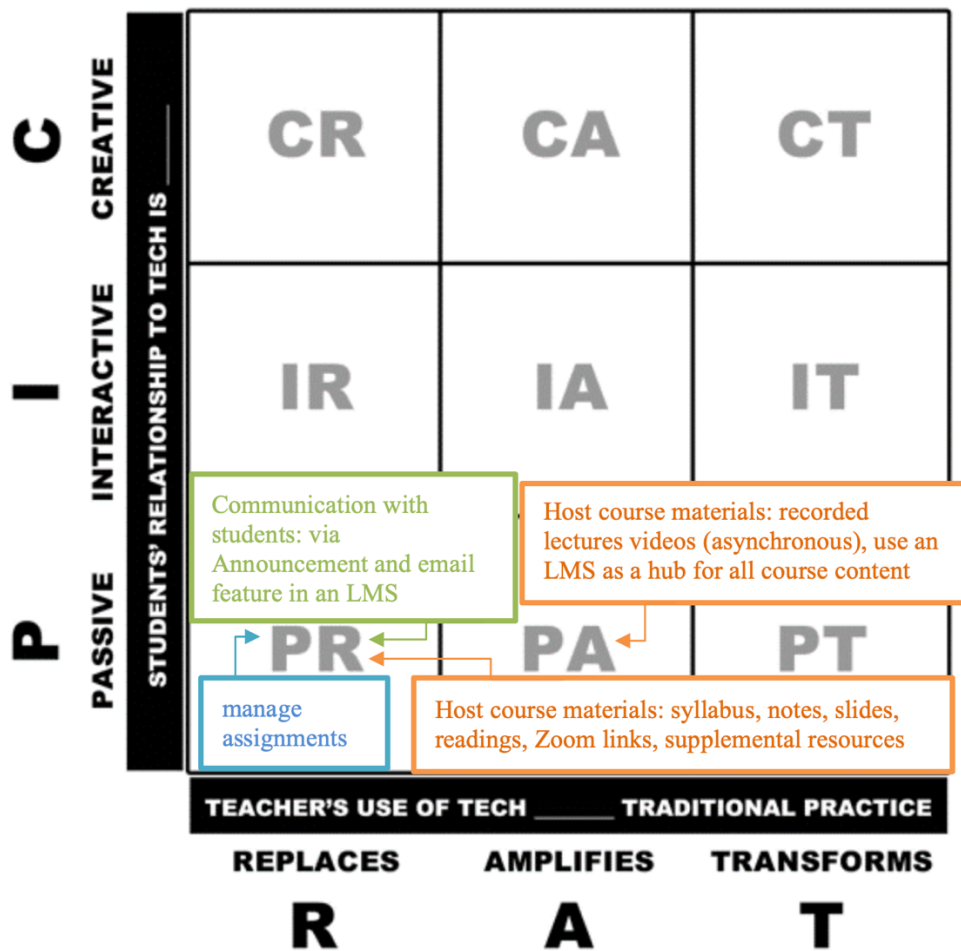
Overall, faculty reported that the most common reason why they used an LMS was to *host course materials*. Based on the limited brief survey responses received from

participants, *host course materials* was located in Passive-Replacement (PR) and Passive-Amplification (PA) on the PICRAT matrix. The following quotes from several faculty members highlight the activities used in an LMS as PR and PA:

Faculty 1: "host required and supplementary course materials" (PR).

Faculty 2: "host course materials, provide links to relevant academic department material" (PR).

Faculty 3: "host course materials, post all readings" (PR).

Faculty 4: "I post materials (video, slides, hangouts)" (PR and PA).

Faculty 5: "I used it to post the syllabus, weekly schedule, videos" (PR and PA).

Faculty 6: "provided access to course materials, including links to videos and synchronous Zoom link" (PR and PA).

Faculty 7: "post lecture notes and recorded lecture videos" (PR and PA).

Faculty 8: "keeping course syllabus, modules, PowerPoint, and supplemental materials all in one place" (PA).

Faculty 9: "I used it to serve as the course website, a hub for course content" (PA).

In these examples, faculty described the provided activities in an LMS such as posting syllabi, lecture notes, slides, hangouts, and Zoom links as simply a replacement of traditional practice; these posts could be a replacement for traditional printed paper form. Students were also just passively receiving content. However, the activities such as faculty posted videos or recorded lecture videos in an LMS were PA, as students could watch videos or review class slides multiple times in any location; therefore, in these cases, faculty's use of an LMS amplified traditional practice. Some faculty reported that

they used the LMS as a central hub for all the course content (see Faculty 8 and 9); in these examples, the activity of using an LMS could be seen as PA, as students could access all the course content in one place anytime and anywhere. While this could also be done with a paper form, it would be much more effort for students to access videos, slides, and other digital materials from paper (e.g., they would have to type in a URL each time, rather than clicking on it in the LMS interface); therefore, faculty's use of an LMS to curate course content in one place amplified traditional practice.

The second main reason why faculty used an LMS was *communication with students*. Based on the limited brief survey responses received from participants, *communication with students* fell in Passive-Replacement (PR) on the PICRAT matrix. The following quotes from different faculty members highlight the activities provided in an LMS as PR:

Faculty 10: "for communication with the class via the Announcements feature" (PR).

Faculty 11: "communications with students; weekly announcements" (PR).

Faculty 12: "Post/send announcements to students" (PR).

Faculty 13: "email students" (PR).

Faculty 14: "I also used Moodle to email the class" (PR).

In these examples, faculty described the activities used in an LMS such as communication with students via the announcement features and email features as PR, as students passively received massages sent from faculty, and faculty' use of an LMS was a replacement of the traditional practice of writing or speaking announcements.

The third main reason for using an LMS was to *manage assignments*. Based on the limited brief survey responses received from participants, *manage assignments* mapped to Passive-Replacement (PR) on the PICRAT matrix. The following quotes from several faculty members highlight the activities used in an LMS as PR:

Faculty 15: "to post, collect, and give feedback on assignments" (PR).

Faculty 16: "I always use my LMS to collect student assignments" (PR).

Faculty 17: "to collect certain kinds of assignments from them [students]" (PR).

Faculty 18: "students upload assignments" (PR).

Faculty 19: "used for assignment dissemination and collection" (PR).

In these examples, faculty described the activities used in an LMS, such as collecting and returning student assignments, which would be PR, as faculty simply used an LMS to replace the traditional way of students' handing in assignments.

Through the lens of the PICRAT model, the analysis suggests that faculty's main reasons for using an LMS—*host course materials*, *communication with students*, and *manage assignments*—were mainly located at the bottom-left corner of the PICRAT matrix. This means that faculty's uses of an LMS were more likely at the Passive-Replacement (PR) level. While some Passive-Amplification (PA) activities occurred, I found there were no higher-level uses of LMS (located at top-right corner of the PICRAT matrix, e.g., Creative-Transformation) in this data set.

5.5 Summary

In this section, I summarize why faculty use an LMS from the analysis of participants' responses of the open-ended questions in the survey. I broke the survey

responses analysis down into the three different LMS platforms and five demographic categories, including: 1) gender, 2) age, 3) years of teaching experience, 4) years of using digital tools, and 5) years of using an LMS. Overall, there were five main reasons why faculty members used an LMS: *host course materials*, *communication with students*, *manage assignments*, *university policy/required*, and *the LMS offered/supported by my university*.

The most common reason to use an LMS indicated by faculty members across all the groups was to *host course materials*. The majority of faculty indicated that their second most common reason to use an LMS was *communication with students*; however, those with less years of teaching experience (1–10 years), less years of using digital tools (≤ 5 years), and less years of using an LMS for teaching (≤ 3 years) seemed more inclined to follow university policy or requirements to use an LMS.

The third most reported reason to use an LMS differed among the groups. One of the third most reported reasons to use an LMS indicated by faculty members was to *manage assignments*. Faculty members who used Moodle indicated that they used the LMS as a tool for managing assignments, while faculty who used Blackboard and Canvas did not specify this as their third common reason to use the LMS. When looking at faculty's age group, faculty 50 years or older reported that *manage assignments* was their third top reason for using an LMS, while faculty members younger than 50 did not specify it. When looking at faculty's teaching experience, faculty with 11–20 years teaching experience indicated *manage assignments* as their third common reason to use an LMS. Similarly, faculty with 11–20 years' experience using digital tools for teaching also indicated *manage assignments* as their third common reason of using an LMS.

Faculty with 10 or less years of teaching experience or over 20 years of teaching experience and faculty with 10 or less years' experience using digital tools or over 20 years' experience using digital tools for teaching seemed not to indicate *manage assignments* as their third common reason of using an LMS.

Other than using an LMS due to university requirements or university support, faculty reported that they mainly used an LMS for hosting course materials, managing assignments, and communicating with students. Using features in the LMS to facilitate learning was not one of the main reported reasons why faculty used an LMS across all three LMS platforms and demographic factors. Interestingly, faculty with 5 or less years of experience using digital tools for teaching did not even report *facilitate learning* as one of the reasons why they used an LMS in this data set.

Even though there were some differences in why faculty used LMS based on their demographics, across the board, their use of LMS was rather limited. Through the lens of the PICRAT model, the analysis of faculty's main reasons why using an LMS suggested that activities used in an LMS were more likely located at the bottom-left level (PR) on the PICRAT matrix. This indicates that faculty mainly use an LMS as a replacement of traditional practices and that students are passively receiving learning content rather than actively being engaged through the LMS. While some PA activities were reported, the higher level LMS uses (towards to the top-right corner of the PICRAT matrix) were not found in this data set.

5.6. RQ2: How do Faculty Use an LMS in U.S. Higher Education?

Participants were asked to describe how they used an LMS in the most recent

semester they taught. Through a thematic analysis (Braun & Clarke, 2006) of the open-

ended responses, I identified a total of eight themes. The codebook for participants'

common themes about how faculty used an LMS are shown in Table 12 and detailed in

the following section.

Table 12

Codebook for Participants' Responses About How Faculty Used an LMS

#	Theme	Description	Example quote
1.	Host course materials	Participants mentioned that they used an LMS to host course materials.	"Posted lecture notes/supplementary materials. Posted lecture recordings."
2.	Communication with students	Participants described that they communicated with students through the announcement or email feature in an LMS.	"Communication with students via Announcements."
3.	Manage assignments	Participants mentioned that they managed all the assignments in an LMS.	"To have students upload assignments and return to them."
4.	Grading/Gradebook	Participants mentioned that they used grading features in an LMS.	"I record my grades on Moodle."
5.	Host quizzes/ exams/tests	Participants mentioned that they used the quiz feature in an LMS or administered tests or online exams.	"I gave weekly quizzes on Moodle."
6.	Facilitate learning activities	Participants described using features provided in an LMS to host some types of learning activities.	"To enable more student interactions, I had students work on activities in groups and discussion threads within Canvas."
7.	Track student progress	Participants mentioned that they used features in an LMS to track students' progress on learning activities or tasks.	"Activity completion monitoring."
8.	Did not respond to this question	Participants did not respond to this question.	N/A

5.6.1 Common Themes in Participants' Reported Approaches for Using an LMS

191 faculty participated in the open-ended prompt and commented on how they used an LMS. As an individual participant could report multiple approaches for using an LMS in each of their comments, an individual comment coded into multiple themes. All the comments generated 598 total codes. Each comment from a participant was coded based on the eight themes.

The most reported theme, across all participants, was *host course materials* ($n = 171$, 90%; 171 out of total 598 codes, 28.6%). This theme refers to faculty using an LMS to host course materials such as syllabi, readings, notes, links, recorded lecture videos, PowerPoint, and supplemental materials and resources. For example, a faculty member who used Moodle reported "posted lecture notes/supplementary materials. Posted lecture recordings," while another faculty shared that he used Blackboard to "host course materials (syllabi, course links, asynchronous lectures)." A faculty member who used Canvas shared, "all the essential course materials such as syllabus and reading files are posted," indicating that they used an LMS as a repertoire for sharing course content and materials.

The second most reported theme, across all participants, was *communication with students* ($n = 101$, 53%; 101 out of total 598 codes, 16.9%). This theme refers to faculty using an LMS to communicate with students through the announcements feature for mass communication or by sending emails through an LMS to students. For example, one faculty member who used Moodle reported that she "use email to communicate with class." A faculty member who used Blackboard responded, "communication with students via Announcements." Another faculty member wrote, "I make announcements

through Canvas." In these examples, faculty shared that they used the email or announcement features in an LMS to communicate with students.

The third most reported theme, across all participants, was *manage assignments* (*n* = 95, 50%; 95 out of total 598 codes, 15.9%). This theme refers to faculty using an LMS as a tool to manage all the assignments. Faculty may post assignments for students, collect assignments from students, and return assignments to students on an LMS. For example, one faculty member shared that she used Moodle "to have students upload assignments and return to them." Another faculty member reported, "Students submit all assignments on Blackboard." One faculty member who used Canvas commented, "It is the major way for my students to submit assignments." In these examples, faculty indicated that they used an LMS to administer students' assignments.

The fourth reported theme, across all participants, was *grading/Gradebook* (*n* = 79, 41%; 79 out of total 598 codes, 13.2%). This theme refers to faculty using grading features to grade students' assignments, submissions, class activities, or assessments. Faculty may also use a Gradebook feature to enter, manage, and publish grades to students. For example, a faculty member reported, "I record my grades on Moodle." Another faculty member responded that "All student grades were posted to Blackboard." One faculty member who used Canvas shared, "I used the Grades feature to grade student work." In these examples, faculty indicated that they used the grading features in an LMS to manage students' grades.

The fifth reported theme, across all participants, was *host quizzes/exams/tests* (*n* = 71, 37%; 71 out of total 598 codes, 11.9%). This theme refers to faculty using the quiz or assessment features in an LMS to host or administer class quizzes, tests, or exams. For

example, one faculty member reported, "I gave weekly quizzes on Moodle." One faculty member used Blackboard to "give quizzes and exams online." Another faculty member responded that he used Canvas to "administer exams and quiz." In these examples, faculty indicated that they used an LMS to give students assessments.

The sixth reported theme, across all participants, was *facilitate learning activities* (n = 62, 32%; 62 out of total 598 codes, 10.4%). This theme refers to faculty using features provided in an LMS to host some types of learning activities, such as using discussion boards/forums for class discussion or interaction. Faculty may provide feedback to students based on the learning activities. For example, a faculty who used Moodle reported, "have students interact with each other in 'Forum.'" One faculty shared that she used Blackboard "to post a discussion thread for in-class activities and occasional async option." One faculty who used Canvas responded, "To enable more student interactions, I had students work on activities in groups and discussion threads within Canvas," while another faculty member who used Canvas also shared that he used "chat rooms for live discussions." In these examples, faculty indicated that they used the discussion forum feature or chat room feature in an LMS for student discussion and interaction.

The seventh reported theme, across all participants, was *track student progress* (n = 13, 7%; 13 out of total 598 codes, 2.2%). This theme refers to faculty using features in an LMS to track students' progress on learning activities or tasks. For example, a faculty member responded that he used Moodle for "activity completion monitoring." One faculty member who used Blackboard Learn shared, "BBL activity reports (to some degree) help me identify special situations," while another faculty member reported that

108

"I also used Canvas to keep track of student progress." In these examples, faculty indicated that they used features in an LMS to track student progress and activity completion.

The eighth reported theme, across all participants, was *did not respond to this question* (*n* = 6, 3%, 6 out of total 598 codes, 1%). This theme refers to participants who did not provide answers as to how they used an LMS. Figure 15 provides a visual representation of the percentages of all codes categorized in eight themes by all participants.

Figure 15

How Faculty Use an LMS
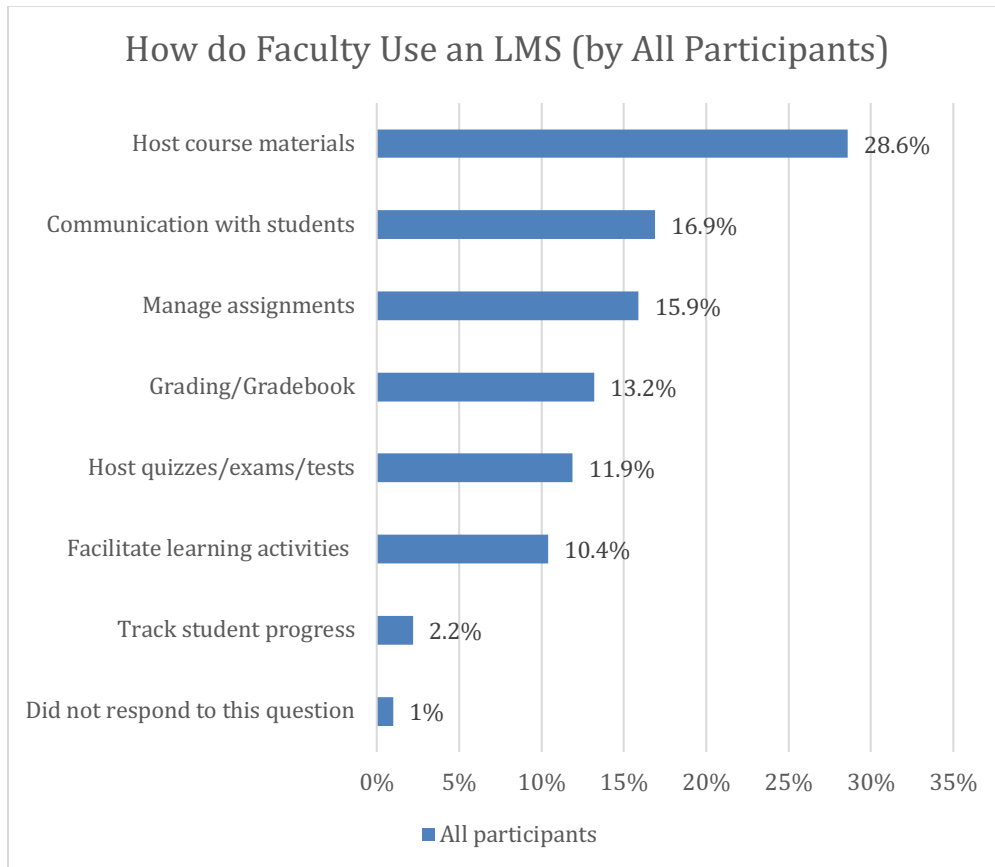
In the following section, I report faculty's common approaches for using an LMS based on the eight identified themes. I provide an examination of how these approaches of using an LMS differed by the three LMS platforms: Moodle, Blackboard Learn, and Canvas.

5.6.2 The Three Most Common Themes in Each LMS Platforms: Moodle, Blackboard Learn, and Canvas

When looking across all three LMS platforms (Moodle: $n = 63$; generating 217 total codes; Blackboard Learn: $n = 62$, generating 183 total codes; Canvas: $n = 66$, generating 198 total codes), there was no difference among the most common reason that faculty used an LMS. The most reported approach as to how faculty used an LMS in the most recent semester they taught was to *host course materials* (Moodle: 28.1%, 61 out of total 217 codes; Blackboard: 30.6%, 56 out of total 183 codes; Canvas: 27.3%, 54 out of total 198 codes). For example, one faculty described, "Posted lecture notes/supplementary materials. Posted lecture recordings." One faculty who used Blackboard reported, "I put all my materials along with multimedia there." Another faculty who used Canvas shared, "post the syllabus, post lecture and lab PowerPoints, post lecture and lab videos." In these examples, hosting course materials meant using an LMS as a hub for course content, such as syllabi, lecture notes, recorded lecture videos, and supplemental materials.

The second most reported approach as to how faculty used an LMS was different based on the LMS platform. Faculty who used Moodle reported *manage assignments* (18%, 39 out of total 217 codes) was the second most common way that they used

110

Moodle. For example, one faculty reported, "collected and returned on 'Assignment' and 'Perusall' (external but connected to LMS)," while another faculty shared, "have students turn assignments in on Moodle too." In these examples, faculty described how they used Moodle as a management tool to collect and return student assignments. Faculty who used Blackboard reported the second most common approach they used the LMS for was *communication with students* (15.3%, 28 out of total 183 codes). For example, one faculty described, "used for communication with the class via the Announcements feature," while another reported, "to email students and/or make announcements." In these examples, faculty indicated that they used the announcements or email features in Blackboard to communicate with students. Faculty who used Canvas also reported the second common approach they used the LMS was *communication with students* (18.7%, 37 out of total 198 codes). For example, one faculty reported, "to post announcements" and "message with students," while another faculty wrote, "centralized email (Canvas Conversations) to stay in touch with my students and communicate with them." In these examples, faculty who used Canvas described how they used the announcement and message features in Canvas to maintain communication with students.

The third most reported approaches as to how faculty used an LMS differed by LMS platforms. Faculty who used Moodle indicated that they used it for *communication with students* (16.6%, 36 out of total 217 codes). For example, one faculty who used Moodle reported, "used announcements; used email to communicate with class," while another faculty shared, "I send announcements to the class via the platforms. Students communicate with me via a discussion forum set up as a 1-on-1 private forum." In these examples, faculty indicated that they used the announcements, email, and discussion

forum features in Moodle to communicate with students. Faculty who used Blackboard reported that they used it to *host quizzes/exams/tests* (14.2%, 26 out of total 183 codes). For example, one faculty wrote, "give quizzes and exams online in Blackboard," while another faculty reported, "to quiz students on the reading." In these examples, faculty indicated that they use Blackboard to give quizzes or tests to students. Faculty who used Canvas indicated that they use it to *manage assignments* (16.2%, 32 out of total 198 codes). For example, one faculty reported, "students also use it to do/submit short assignments," while another faculty shared, "it is the major way for my students to submit assignments." In these examples, faculty described that they used Canvas for students to submit assignments.

The findings from this data set show that faculty across the three LMS platforms indicated that their most common approach for using an LMS was to *host course materials*. There were some differences in the second and third common approaches for using an LMS across the three LMS platforms. Faculty seemed most likely to use an LMS for *communications with students*, to *manage assignments*, and to *host quizzes/exams/tests*. Figure 16 provides a visual representation of percentages of all codes categorized in eight themes by the three LMS platforms.

Figure 16

How Faculty Use an LMS, by Three LMS Platforms

How do Faculty Use an LMS in the Most Recent Semester They Taught by Three LMS Platforms?

Host course materials: Moodle 28.1%, Blackboard 30.6%, Canvas 27.3%

Communicate with students: Moodle 16.6%, Blackboard 15.3%, Canvas 18.7%

Manage assignments: Moodle 18%, Blackboard 13%, Canvas 16.2%

Grading/Gradebook: Moodle 12.4%, Blackboard 11.5%, Canvas 15.7%

Host quizzes/exams/tests: Moodle 12.9%, Blackboard 14.2%, Canvas 8.6%

Facilitate learning activities: Moodle 8.3%, Blackboard 11.5%, Canvas 11.6%

Track student progress: Moodle 3.7%, Blackboard 1.6%, Canvas 1%

Did not respond to this question: Moodle 0%, Blackboard 2.2%, Canvas 1%

■ Moodle ■ Blackboard ■ Canvas

5.6.3 The Three Least Common Themes in Each LMS Platforms: Moodle, Blackboard Learn, and Canvas

Overall, the two least reported themes out of the total eight identified across the

three different LMS platforms were the same: *track student progress* (Moodle: 3.7%, 8

out of total 217 codes; Blackboard: 1.6%, 3 out of total 183 codes; Canvas: 1%, 2 out of

total 198 codes) and *did not respond to this question* (Moodle: 0%, 0 out of total 217 codes; Blackboard: 2.2%, 4 out of total 183 codes; Canvas: 1%, 2 out of total 198 codes). These findings indicated that faculty across the three LMS platforms rarely reported using features in an LMS to track student progress.

The third least reported theme was different across the three LMS platforms. Faculty who used Moodle reported *facilitate learning activities* (8.3%, 18 out of total 217 codes) as the third least approach of how they used an LMS. Faculty who used Blackboard reported both *facilitate learning activities* (11.5%, 21 out of total 183 codes) and *grading/Gradebook* (11.5%, 21 out of total 183 codes) as the third least common way in which they used an LMS. Faculty who used Canvas reported *host quizzes/exams/tests* (8.6%, 17 out of total 198 codes) as the third least reported approach of how they used an LMS.

The findings from this data set showed that faculty rarely reported using features in an LMS to track student progress across all the three LMS platforms. Faculty who used Moodle and Blackboard indicated that *facilitate learning activities* was one of the least common approaches to using an LMS. Faculty who used Blackboard also indicated that the *grading/Gradebook* feature was one of their least common approaches to using an LMS, while faculty who used Canvas indicated that *hosting quizzes/tests/exams* was one of their least common approaches to using an LMS. These findings indicated that faculty were more likely to use an LMS as a hub to curate course materials rather than to design activities and facilitate learning in an LMS.

5.7 RQ2a: What is the Relationship Between Demographic Factors and How Faculty Use an LMS in U.S. Higher Education?

In the following section, I report faculty's common approaches to use an LMS based on the eight identified themes as differentiated by five demographic factors: 1) gender, 2) age, 3) years of teaching experience, 4) years of using digital tools, and 5) years of using an LMS.

5.7.1 Gender

When looking at the gender of participants (female: $n = 125$, generating 409 total codes; male: $n = 66$, generating 189 total codes), there were no differences between faculty who identified as female and faculty who identified as male in the most common approach to using an LMS. The most common theme across each gender was to *host course materials* (female: 28.6%, 117 out of total 409 codes; male: 28.6%, 54 out of total 189 codes). For example, a female faculty who used Moodle reported, "links to external resources they need. Syllabus with course calendar uploaded," while a male faculty shared, "I post all of my slides, notes, and in-class exercises on Blackboard." In these examples, *hosting course materials* meant using an LMS as hub for course content such as external resources links, syllabus, slides, notes, and exercises.

Female and male faculty also reported the same second most common approach to using an LMS: *communication with students* (female: 17.1%, 70 out of total 409 codes, male: 16.4%, 31 out of total 189 codes). For example, one female faculty described, "I used Moodle mainly for communicating with students (through the email system)," while a male faculty who used Canvas shared, "communicate with students through messages

and announcements." In these examples, faculty indicated that they used the announcement and email/message features in an LMS for communication with students.

Differences did emerge regarding the third most common approach to using an LMS by gender. Female faculty indicated that they used an LMS to *manage assignments* (16.4%, 67 out of total 409 codes), whereas male faculty reported that they used an LMS for *grading/Gradebook* (15.9%, 30 out of total 189 codes). For example, one female faculty who used Blackboard wrote, "use for assignment dissemination and collection," while another female faculty who used Canvas shared, "I also use it to let students submit assignments and grade accordingly." On the other hand, one male faculty who used Moodle simply wrote, "grade students' work… and track students' attendance," while another male faculty who used Blackboard shared, "provide grades and feedback (including annotation on papers)." In these examples, female faculty indicated that they used an LMS to receive students' assignments, while male faculty indicated that they used the grading feature in the LMS.

The findings from this data set showed that female and male faculty indicated that their two most common approaches to using an LMS were to *host course materials* and *communication with students*. While male faculty reported *grading/Gradebook* as their third common approach to using an LMS, female faculty did not report this case. One female faculty who used Moodle shared her view about grading in the follow-up interview:

> I wouldn't say I ever reconsider not using Moodle at all. I've occasionally wondered about the grading, of my approach to grading. And, I actually think it's better for students to not get number grades, but rather get written feedback.

In this case, the female faculty shared her perspectives on grading students, which might indicate why she was less likely to use the grading features in an LMS.

Faculty, based on gender, did not report *facilitate learning activities* as one of their common approaches to using an LMS (female: 10.8%, 44 out of total 409 codes; male: 9.5%, 18 out of total 189 codes).

Figure 17

How Faculty Use an LMS, by Gender
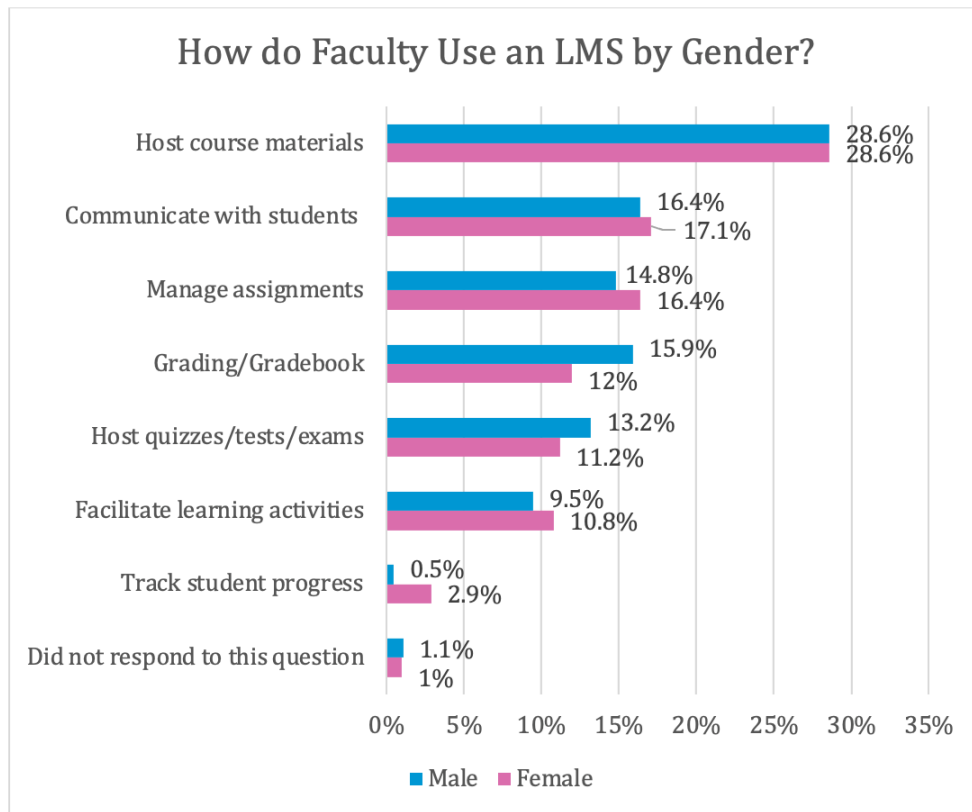
Figure 17 provides a visual representation of the percentages of all codes categorized in eight themes by gender. These findings indicate that faculty were more

likely to use an LMS as a hub to curate course materials and to communicate with students rather than to design activities and facilitate learning in an LMS.

5.7.2 Age

When looking at the themes based on the three different age groups of faculty members (≤ 40 years old: $n = 71$, 230 total codes; 41–49 years old: $n = 60$, 182 total codes; ≥ 50 years old: $n = 60$, 186 total codes), there was no difference among the most common approach to use an LMS across the three different age groups. The most reported approach as to how faculty used an LMS was to *host course materials* (≤ 40 years old: 28.3%, 65 out of total 230 codes; 41–49 years old: 29.1%, 53 out of total 182 codes; ≥ 50 years old: 28.5%, 53 out of total 186 codes). For instance, a faculty aged 40 years or younger described, "I used it [Moodle] to post lecture checklist, and host course materials," while a faculty aged 41 to 49 years reported that she, "housed all relevant course and department materials for student access" in Blackboard. Another faculty aged 50 years or older shared that she used Canvas and "posted lecture notes, videos and other online resources." In these examples, faculty described how they used an LMS as a platform to provide all course materials and relevant resources.

Faculty members reported differently for their second most common approaches for using an LMS amongst the three different age groups. Faculty members aged 40 years or younger and faculty aged 50 or older indicated that they used an LMS for *communication with students* (≤ 40 years old: 17.4%, 40 out of total 230 codes; ≥ 50 years old: 18.3%, 34 out of total 186 codes). For example, one faculty aged 40 years or younger shared, "I also used the Moodle email function to contact students both *en masse*

and individually, since this was the easiest way to get their emails," while another faculty aged 50 years or older wrote "Communicate- through very frequent announcements, targeted and individual emails." In these examples, faculty aged 40 years or younger and faculty aged 50 years or older tended to communicate with students through the email and announcements feature in an LMS. Faculty members aged 41–49 years reported their second most common approach to using an LMS was to *manage assignments* (17%, 31 out of total 182 codes). For example, one faculty wrote, "I have assignment descriptions and locations for students to submit assignments," while another faculty shared, "all assignments were posted to Blackboard and either done directly online in Blackboard or uploaded to Blackboard." In these examples, faculty aged 41–49 years indicated that they used an LMS for students to complete assignments or to upload their assignments.

The third common approach as to how faculty members used an LMS varied among age groups. Faculty aged 40 years or younger reported that they used an LMS for *grading/Gradebook* (15.7%, 36 out of total 230 codes). For example, one faculty who used Blackboard simply wrote, "post grades and provided feedback to students," while another faculty shared, "Grading—using rubrics and providing feedback is a big part of Canvas." In these examples, faculty aged 40 years or younger indicated that they used grading features in an LMS for students' grades. Faculty aged 41–49 years reported that they used an LMS for *communication with students* (14.8%, 27 out of total 182 codes). For example, one faculty shared, "I also use Moodle to send out course emails to the entire group," while another faculty who used Canvas wrote, "communicate with the course participants, and post announcements." In these examples, faculty aged 41–49 years indicated that they used the email or announcements features in an LMS to

communicate with students. Faculty members aged 50 years or older reported that they used an LMS to *manage assignments* (16.7%, 31 out of total 186 codes). For example, one faculty shared, "post and receive assignments; return graded assignments," while another faculty simply commented, "Assignments—for all submissions." In these examples, faculty aged 50 years or older indicated that they used an LMS for students to submit assignments and to return assignments to them. Figure 18 provides a visual representation of the percentages of all codes categorized in eight themes by age groups.

Figure 18

How Faculty Use an LMS, by Age

How do Faculty Use an LMS by Age?

Category	≤ 40 years old	41-49 years old	≥ 50 years old
Host course materials	28.3%	29.1%	28.5%
Communication with students	17.4%	14.8%	18.3%
Manage assignments	14.3%	17%	16.7%
Grading/Gradebook	15.7%	12.1%	11.3%
Host quizzes/exams/tests	11.7%	13.7%	10.2%
Facilitate learning activities	8.7%	10.4%	12.4%
Track student progress	2.6%	1.6%	2.2%
Did not respond to this question	1.3%	1.1%	0.5%

120
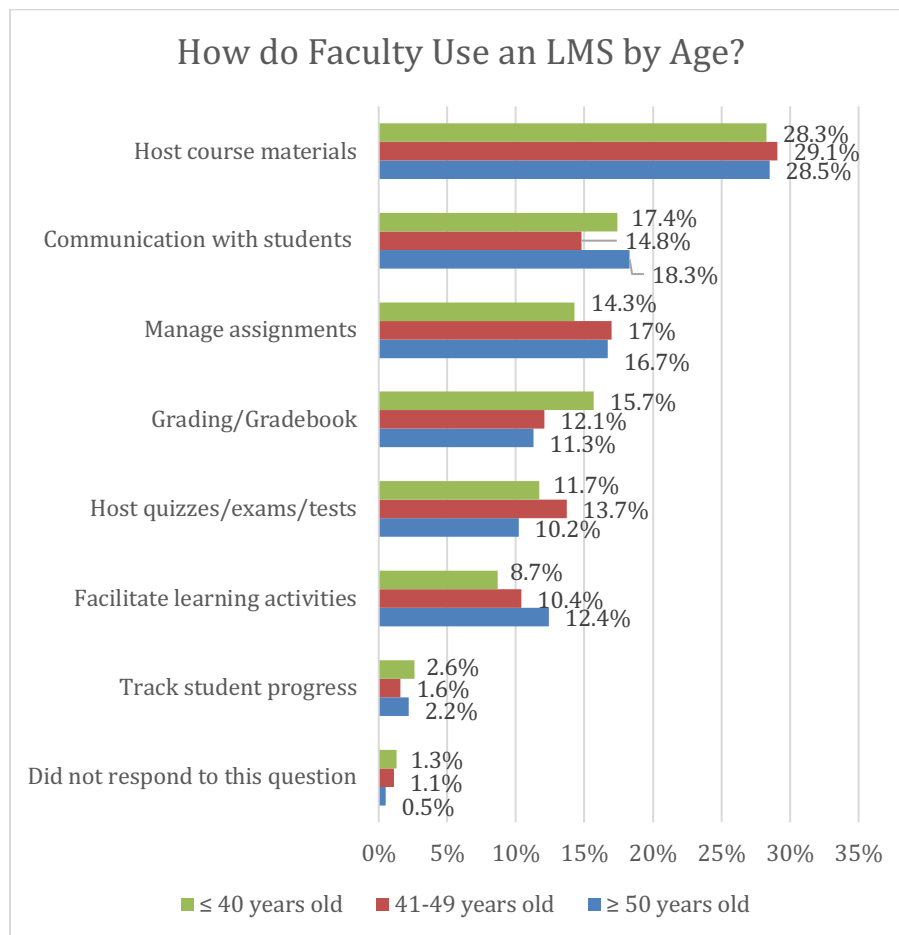
Overall, the findings in this data set showed that faculty tended to use an LMS to host course materials, as this was the most common approach as to how faculty used an LMS across the three age groups. Faculty indicated other common approaches to use an LMS, such as *communication with students*, *manage assignments* and *grading/Gradebook*. However, using an LMS to *facilitate learning activities* was not one of the main approaches as to how faculty used an LMS across all the three age groups (≤ 40 years old: 8.7%, 20 out of total 230 codes; 41–49 years old: 10.4%, 19 out of total 182 codes; ≥ 50 years old: 12.4%, 23 out of total 186 codes). These findings indicated that faculty across all the age groups were more likely to use an LMS as a hub to curate course materials rather than to design activities and facilitate learning in an LMS.

5.7.3 Years of Teaching Experience

When looking at the themes based on years of teaching experience (≤ 10 years: *n* = 76, generating 242 total codes; 11–20 years: *n* = 58, generating 187 total codes; 20+ years: *n* = 56, generating 169 total codes), there was no difference in the most reported approach as to how they used an LMS across the three groups. The most common approach as to how faculty used an LMS was to *host course materials* (≤ 10 years: 28.1%, 68 out of total 242 codes; 11–20 years: 26.7%, 50 out of total 187 codes; 20+ years: 31.4%, 53 out of total 169 codes). For example, one faculty with 10 or less years of teaching experience reported, "I use to post lecture videos and notes," while another faculty with 11 to 20 years of teaching experience wrote, "I shared with them [students] lecture notes, pre-recorded lectures, optional material." One faculty with more than 20 years of teaching experience shared, "I use Canvas for many instructional activities. I

host lectures. I post videos and links to resources outside of assigned course texts." In these examples, faculty tended to use an LMS as a platform to provide course materials and resources.

The second most reported approach to use an LMS was different among the three groups. Faculty with 10 or less years and faculty with 11 to 20 years of teaching experience indicated that they used an LMS for *communication with students* ($\leq$ 10 years: 16.9%, 41 out of total 242 codes; 11–20 years: 18.7%, 35 out of total 187 codes), while faculty who had taught over 20 years reported they used an LMS to *manage assignments* (17.2%, 29 out of total 169 codes). For example, one faculty with 10 or less years of teaching experience described, "I communicate with students via Announcements through Moodle," while another faculty with 11 to 20 years of teaching experience wrote, "I communicated with students through the LMS email and announcements tools." In these examples, faculty indicated that they used announcements and email features in an LMS to communicate with students. One faculty who had taught over 20 years simply wrote, "collected written assignments," while another faculty shared, "I used the LMS to disseminate assignments… for students to submit assignments." In these examples, faculty who had taught over 20 years indicated that they use an LMS to distribute and collect students' assignments.

The third most reported approach to use an LMS was different across the three groups of teaching experience. Faculty with 10 or less years of teaching experience reported they used an LMS for *grading/Gradebook* (15.3%, 37 out of total 242 codes). For example, one faculty shared, "grade students' work… and track students' attendance," indicating that faculty graded students' assignments through an LMS.

Faculty with 11 to 20 years of teaching experience reported they used an LMS to *manage assignments* (17.1%, 32 out of total 187 codes). For example, a faculty shared, "I logged in daily to check for assignments that student submitted," indicating that faculty used an LMS to receive students' submitted assignments. Faculty who had taught over 20 years reported that they used an LMS for *communication with students* (14.8%, 25 out of total 169 codes). For instance, a faculty shared, "I used the platform to communicate to students (mail and forums)," indicating that faculty used email and forum features in an LMS to communicate with students. Figure 19 provides a visual representation of the percentages of all codes categorized in eight themes by faculty members' teaching experience.

Figure 19

How Faculty Use an LMS, by Teaching Experience
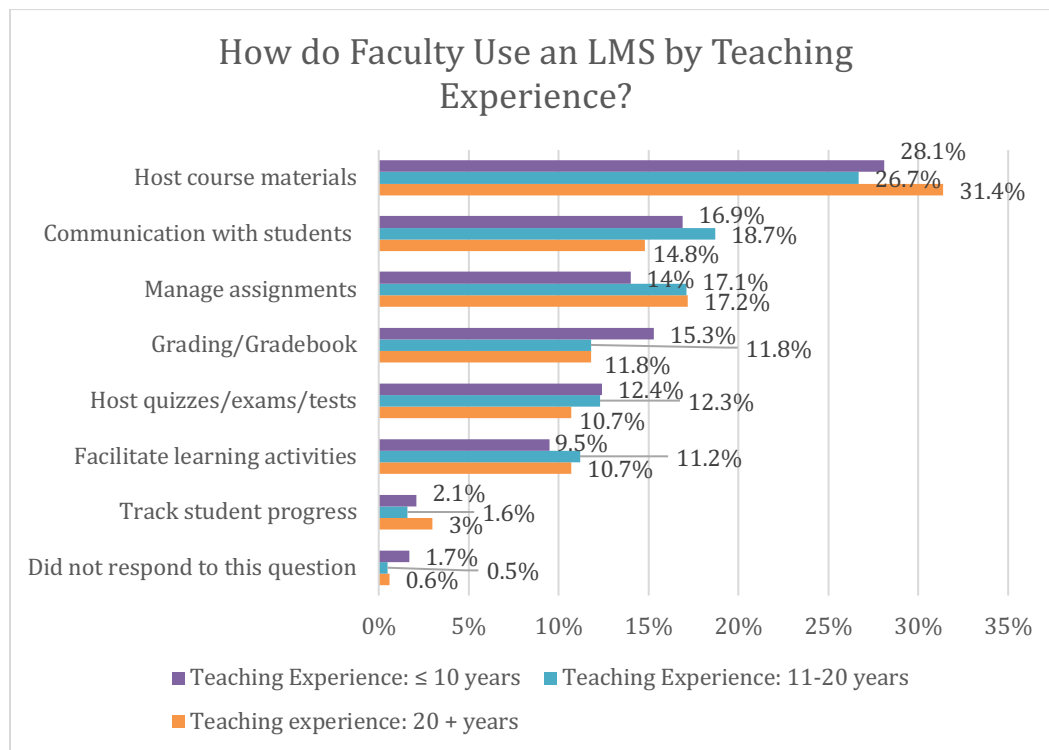
Overall, these findings indicated that faculty tended to use an LMS to *host course materials*, as this is the most reported approach as to how faculty used an LMS across the three groups of teaching experience. The faculty indicated other common approaches to use an LMS, such as *communication with students*, *manage assignments* and *grading/Gradebook*. However, using an LMS to *facilitate learning activities* was not one of the main reported approaches that faculty used an LMS across all the three groups of teaching experience ($\leq$ 10 years: 9.5%, 23 out of total 242 codes; 11–20 years: 11.2%, 21 out of total 187 codes; 20+ years: 10.7%, 18 out of total 169 codes). These findings indicate that faculty across all the three groups of teaching experience were more likely to use an LMS as a hub to curate course materials rather than to design activities and facilitate learning in an LMS.

5.7.4 Years of Using Digital Tools

When looking at the themes based on the five different groups of faculty members' years of using digital tools for teaching, there was no difference in the most commonly reported approach as to how faculty used an LMS ($\leq$ 5 years: $n = 42$, generating 120 total codes; 6–10 years: $n = 43$, generating total 135 codes; 11–15 years: $n = 44$, generating 145 total codes; 16–20 years: $n = 33$, generating total 109 codes; 20+ years: $n = 29$, generating 89 total codes). The most reported approach across the five groups was to *host course materials* ($\leq$ 5 years: 30.8%, 37 out of total 120 codes; 6–10 years: 28.9%, 39 out of total 135 codes; 11–15 years: 28.3%, 41 out of total 145 codes; 16–20 years: 26.6%, 29 out of total 109 codes; 20+ years: 28.1%, 25 out of total 89 codes). For example, one faculty with 5 or less years of using digital tools reported, "it is

the central platform for all course systems. Readings, pre-recorded lectures, films," while another faculty with 6 to 10 years of using digital tools experience described, "I use it for everything. All of my materials (PowerPoint, handouts, etc.) is located in Blackboard." One faculty with 11 to 15 years of using digital tools experience reported, "host course materials and learning modules, example files, embed tutorial videos." Another faculty with 16 to 20 years of using digital tools experience described,

> I used Moodle to post my syllabus with a week-by-week reading schedule. It also hosted many of the readings. It contained links to my Echo360 recordings of each class. After each class I uploaded my Power Point to the Moodle site.

One faculty with over 20 years of using digital tools for teaching reported, "I post all course materials—syllabi, PowerPoint presentations, assignments, recorded classes and recorded lectures." In these examples, faculty across all different groups of using digital tools experience indicated that they used an LMS as a platform to curate course material and resources.

Faculty members used an LMS differently for their second and third common approaches among the five different groups by experience using digital tools. Faculty with 5 or less years of using digital tools indicated they used an LMS for *communication with students* (15.8%, 19 out of total 120 codes), followed by using an LMS to *manage assignments* (14.2%, 17 out of total 120 codes). For example, one faculty wrote, "I communicated with students via Announcements through Moodle." Another faculty described, "It is the major way for my students to submit assignments." In these

examples, faculty indicated that they used an LMS to communicate with students and for students to submit assignments.

Faculty with 6 to 10 years' experience using digital tools indicated they used an LMS for *communication with students* (18.5%, 25 out of total 135 codes), followed by using an LMS for *grading/Gradebook* (16.3%, 22 out of total 135 codes). For example, one faculty shared, "Moodle was also where I posted all announcements and general communication with students, as well as all grades/assignment feedback." One faculty wrote, "I email students through Blackboard and use Blackboard's Gradebook," while another faculty reported, "I make announcements through Canvas. I also use it to let students submit assignments and grade accordingly." In these examples, faculty indicated that they used the announcements or email features to communicate with students and that they graded students' assignments in an LMS.

Faculty with 11 to 15 years' experience using digital tools indicated they used an LMS for *communication with students* (16.6%, 24 out of total 145 codes), followed by using an LMS to *manage assignments* (15.9%, 23 out of total 145 codes). For example, one faculty shared, "used for communication with the class via the Announcements feature, used for assignment dissemination and collection," while another faculty wrote, "Communication with students (announcements). Assignment submission." In these examples, faculty indicated that they used the announcements feature to communicate with students and collected students' assignments in the LMS.

Faculty with 16 to 20 years' experience using digital tools indicated they used an LMS to *manage assignments* (19.3%, 21 out of total 109 codes), followed by using an LMS for *communication with students* (15.6%, 17 out of total 109 codes). For example,

one faculty wrote, "have students turn assignments in on Moodle too," while another faculty shared, "To communicate, by using the messaging tools." In these examples, faculty indicated that they used an LMS for students to submit assignments and used the message feature to communicate with students in an LMS.

Faculty with more than 20 years of experience using digital tools reported they used an LMS for *communication with students* (18%, 16 out of total 89 codes) and to *manage assignments* (18%, 16 out of total 89 codes). For example, one faculty reported, "I have assignment descriptions and locations for students to submit assignments," while another faculty wrote, "Students submit all assignments on Blackboard." One faculty shared, "We post course announcements and students communicate with us via Canvas," while another faculty reported, "I still primarily use the LMS for communication, collecting assignments." In these examples, faculty indicated that they used an LMS to communicate with students and to collect students' assignments.

Figure 20 provides a visual representation of the percentages of all codes categorized in eight themes by faculty members' experience using digital tools for teaching.

Figure 20

How Faculty Use an LMS, by Years of Using Digital Tools

How do Faculty Use an LMS by Years of Using Digital Tools?

Host course materials
- 30.8%
- 28.9%
- 28.3%
- 26.6%
- 28.1%

Communication with students
- 15.8%
- 18.5%
- 16.6%
- 15.6%
- 18%

Manage assignments
- 14.2%
- 13.3%
- 15.9%
- 19.3%
- 18%

Grading/Gradebook
- 11.7%
- 16.3%
- 13.1%
- 11.9%
- 12.4%

Host quizzes/exams/tests
- 12.5%
- 9.6%
- 14.5%
- 11.9%
- 10.1%

Facilitate learning activities
- 8.3%
- 12.6%
- 10.3%
- 10.1%
- 10.1%

Track student progress
- 3.3%
- 0.7%
- 1.4%
- 3.7%
- 2.2%

Did not respond to this quesiton
- 3.3%
- 0%
- 0%
- 0.9%
- 1.1%

Axis: 0.0% 5.0% 10.0% 15.0% 20.0% 25.0% 30.0% 35.0%

Legend:
- Years of using digital tools: ≤ 5 years
- Years of using digital tools: 6-10 years
- Years of using digital tools: 11-15 years
- Years of using digital tools: 16-20 years
- Years of using digital tools: 20 + years

128

Overall, the findings show *host course materials* was faculty's most common approach as to how LMS is used across all five groups of experience using digital tools. Faculty indicated other common approaches to use an LMS, such as *communication with students*, *manage assignments*, and *grading/Gradebook*. However, the findings in this data set indicated that *facilitate learning activates* was not one of the three common approaches as to how faculty used an LMS across all the five groups of experience using digital tools for teaching (≤ 5 years: 8.3%, 10 out of total 120 codes; 6–10 years: 12.6%, 22 out of total 135 codes; 11–15 years: 10.3%, 15 out of total 145 codes; 16–20 years: 10.1%, 11 out of total 109 codes; 20+ years: 10.1%, 9 out of total 89 codes). These findings indicate that faculty were more likely to use an LMS as a hub to curate course materials rather than to design activities and facilitate learning in an LMS, no matter their experience using digital tools for teaching.

5.7.5 Years of Using an LMS

When looking at the themes based on the years of experience using an LMS (≤ 3 years: $n = 49$, generating 139 total codes; 4–6 years: $n = 54$, generating total 174 codes; 7–9 years: $n = 39$, generating 118 total codes; ≥10 years: $n = 49$, generating total 167 codes), there was no difference in the most common approach as to how faculty used an LMS in the most recent semester they taught. The most reported approach across the four groups of faculty members was to *host course materials* (≤ 3 years: 28.8%, 40 out of total 139 codes; 4–6 years: 29.3%, 51 out of total 174 codes; 7–9 years: 29.7%, 35 out of total 118 codes; ≥ 10 years: 26.9%, 45 out of total 167 codes). For example, one faculty with 3 or less years of using an LMS described, "All the essential course material such as

129

syllabus and readings files are posted," while another faculty with 4 to 6 years of using an LMS wrote, "Posted lecture notes/supplementary materials. Posted lecture recordings." One faculty with 7 to 9 years of using an LMS reported, "I use it for everything. All of my materials (PowerPoint, handouts, etc.) is located in Blackboard," while another faculty with 10 or more years of using an LMS shared, "I organize it based on material for an exam. So, I generally put lectures, slides, links to extra sources all in a folder per that exam (i.e., 'Material for Exam 1')." In these examples, faculty across all four groups of years of experience using an LMS showed that their most common approach to use an LMS was to host courses materials and resources.

The second most common and third most common approaches among the four groups by experience using an LMS were different: faculty with 3 or less years of experience using LMS for teaching indicated they used an LMS for *communication with students* (15.8%, 22 out of total 139 codes), followed by using an LMS for *grading/Gradebook* (15.1%, 21 out of total 129 codes). For example, a faculty wrote, "I make announcements through Canvas," while another faculty shared, "I used the Grades feature to grade student work." In these examples, faculty indicated that they used the announcements feature to communicate with students and the grading feature to grade student work in an LMS.

Faculty with 4 to 6 years of experience using an LMS indicated they used an LMS to *manage assignments* (17.8%, 31 out of total 174 codes), followed by using an LMS for *communication with students* (17.2%, 30 out of total 174 codes). For example, a faculty wrote, "had them [students] submit their final papers in Turnitin," while another faculty shared, "communicate with students via Announcement and Emails." In these examples,

faculty indicated that they used the Turnitin feature for students to submit assignments, and they also used the announcement and email features to communicate with students in an LMS.

Faculty with 7 to 9 years' experience using an LMS indicated they used an LMS for *communication with students* (18.6%, 22 out of total 118 codes), followed by using an LMS to *manage assignments* (16.9%, 20 out of total 118 codes). For example, a faculty wrote, "Communication with students (announcements), assignment submission." One faculty reported, "I also use Moodle to send out course emails to the entire group," while another faculty shared, "I used the LMS to disseminate assignments and materials; for students to submit assignments." In these examples, faculty indicated that they used the announcement or email features to communicate with students, and that they used an LMS for students to submit assignments.

Faculty who had 10 or more years of experience using an LMS indicated that they used an LMS for *communication with students* (16.2%, 27 out of total 167 codes), followed by using an LMS to *manage assignments* (15.6%, 26 out of total 167 codes). For example, one faculty wrote, "used Announcements; used Email to communicate with class," while another faculty shared, "I communicated with students through the LMS Email and Announcement tools." One faculty reported, "used for assignment dissemination and collection," while another faculty shared, "All assignments were posted to Blackboard and either done directly online in Blackboard or uploaded to Blackboard." In these examples, faculty indicated that they communicated with students through the announcement and email features in an LMS, and they used an LMS to distribute and collect student assignments.

131

Figure 21 provides a visual representation of the percentages of all codes categorized in eight themes by faculty members' experience using an LMS for teaching.

Figure 21

How Faculty Use an LMS, by Years of Using an LMS
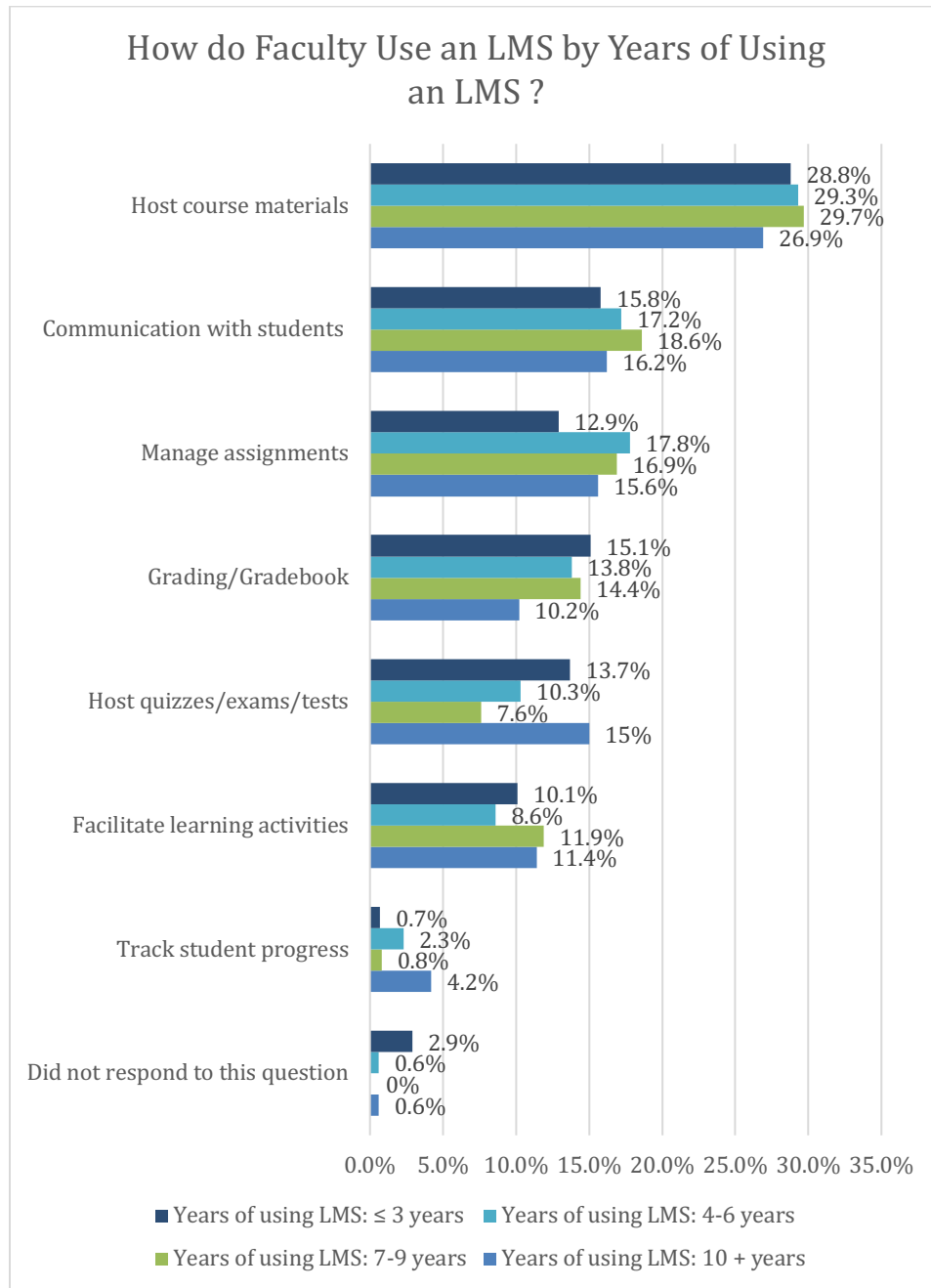
How do Faculty Use an LMS by Years of Using an LMS ?

Overall, faculty tended to use an LMS to *host course materials*, as this was the most reported approach across the four groups of experience using an LMS for teaching. Faculty indicated other common approaches to using an LMS, such as *communication with students*, *manage assignments*, and *grading/Gradebook*. However, the findings in this data set indicated that *facilitate learning activates* was not one of the three common approaches as to how faculty used an LMS across all the four groups of experience using an LMS for teaching (≤ 3 years: 10.1%, 14 out of total 139 codes; 4–6 years: 8.6%, 15 out total 174 codes; 7–9 years: 11.9%, 14 out of total 118 codes; ≥ 10 years: 11.4%, 19 out of total 167 codes). Faculty were more likely to use an LMS as a hub to curate course materials rather than to design activities and facilitate learning in an LMS.

5.8 Examining How Faculty Use an LMS Through the Lens of the PICRAT Model

In this section, I first summarize faculty's main approaches for using an LMS from the analysis of participants' responses to the open-ended prompt. I broke the summary of responses down into six groups: 1) the three LMS platforms, 2) gender, 3) age, 4) years of teaching experience, 5) years of using digital tools, and 6) years of using an LMS. Then, I examined faculty's main approaches for using an LMS by mapping the responses to the PICRAT matrix.

Overall, faculty across the six groups reported the following five common approaches as to how they used an LMS: 1) *host course materials*, 2) *communication with students*, 3) *manage assignments*, 4) *host quizzes/exams/tests*, and 5) *grading/Gradebook*. Table 13 presents the summary of the main approaches as to how faculty used an LMS across the six groups.

Table 13

Summary of Results – How Faculty Use an LMS

Group	Subgroup	How do Faculty Use an LMS?		
		First main approach	Second main approach	Third main approach
LMS platforms	Moodle	host course materials	manage assignments	communication with students
	Blackboard	host course materials	communication with students	host quizzes/exams/tests
	Canvas	host course materials	communication with students	manage assignments
Demographic				
Gender	Man	host course materials	communication with students	grading/Gradebook
	Woman	host course materials	communication with students	manage assignments
Age	≤ 40	host course materials	communication with students	grading/Gradebook
	41–49	host course materials	manage assignments	communication with students
	≥ 50	host course materials	communication with students	manage assignments
Years of Teaching experience	1–10	host course materials	communication with students	grading/Gradebook

	11–20	host course materials	communication with students	manage assignments
	20 +	host course materials	manage assignments	communication with students
Years of using digital tools	≤5	host course materials	communication with students	manage assignments
	6–10	host course materials	communication with students	grading/Gradebook
	11–15	host course materials	communication with students	manage assignments
	16–20	host course materials	manage assignments	communication with students
	20 +	host course materials	communication with students manage assignments	*See previous column
Years of using LMS	≤ 3	host course materials	communication with students	grading/Gradebook
	4–6	host course materials	manage assignments	communication with students
	7–9	host course materials	communication with students	manage assignments
	≥ 10	host course materials	communication with students	manage assignments

The evaluation method of mapping the themes for how faculty used an LMS are the same as the method for mapping why faculty used an LMS to the PICRAT matrix in the

previous section in this chapter. Using this evaluation method, I determined where these themes were located on the PICRAT matrix. Figure 22 provides a visual presentation categorizing the themes for how faculty used an LMS within a PICRAT matrix.

Figure 22

Themes for How Faculty Used an LMS Mapped to the PICRAT Matrix
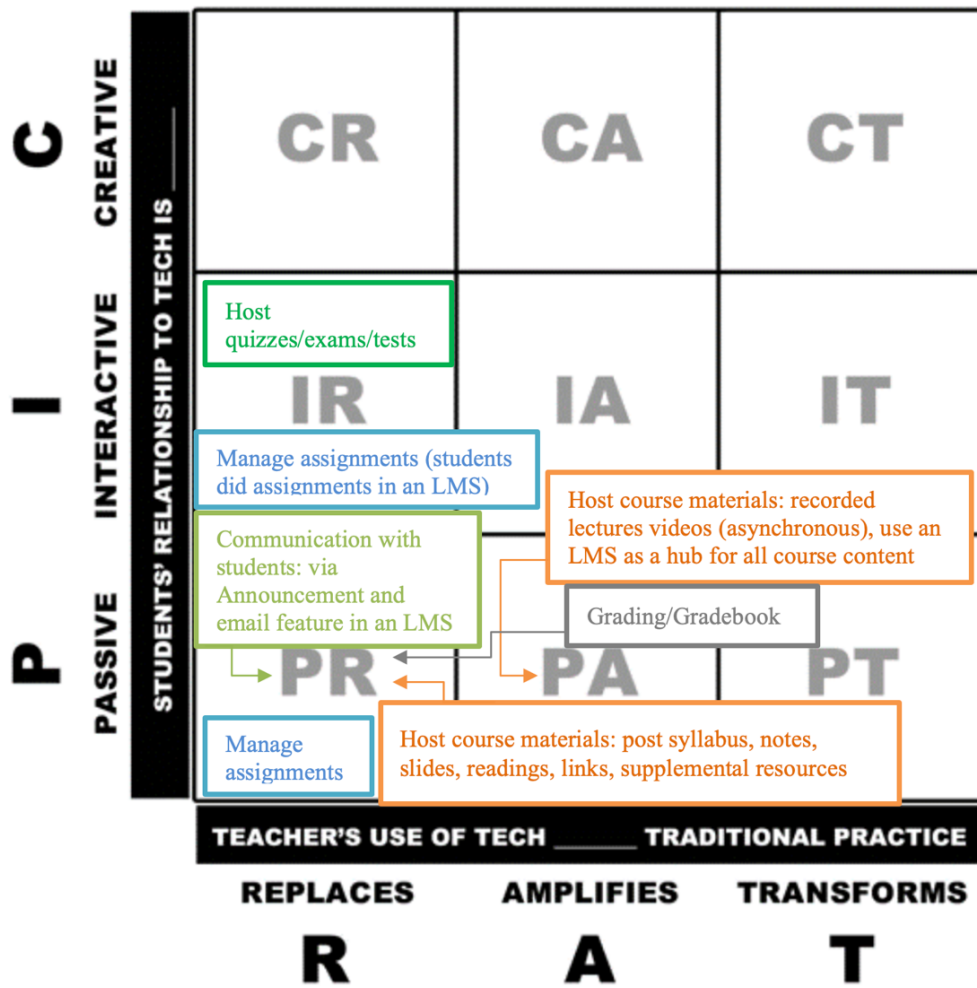
Overall, faculty reported that the most common approach as to how they used an LMS was to *host course materials*. Based on the limited brief survey responses received by participants, *host course materials* mapped to Passive-Replacement (PR) and Passive-

Amplification (PA) on the PICRAT matrix. The following quotes from several faculty members highlight the activities used in an LMS as PR and PA:

Faculty 1: "Hosted the course pack (syllabus, calendar, readings, supplementary materials)" (PR).

Faculty 2: "All of my materials (PowerPoint, handouts, etc.) is located in Blackboard" (PR).

Faculty 3: "All the essential course material such as syllabus and readings files are posted" (PR).

Faculty 4: "Posted lecture notes/supplementary materials. Posted lecture recordings" (PR, PA).

Faculty 5: "My Moodle site was organized by weeks, and in each week students found the material corresponding to that week. I shared with them lecture notes, pre-recorded lectures, optional material" (PR, PA).

Faculty 6: "Linked to lecture videos; posted syllabus, lecture notes, homeworks, solutions, exam preparation materials" (PR, PA).

Faculty 7: "Upload recorded lectures, distribute course materials such as lab exercises and readings" (PR, PA).

Faculty 8: "It is the central platform for all course systems. Readings, pre-recorded lectures, films" (PR, PA).

Faculty 9: "I use Moodle as the central (and up-to-date) repository of course information and materials for students in my classes" (PR, PA).

In these examples, faculty described the provided materials in an LMS, such as posting syllabi, lecture notes, slides, hangouts, links, and readings, as simply a replacement of

traditional practice (PR); these posts were a replacement for traditional printed paper forms. Students were also passively receiving content. However, materials like faculty posted videos or recorded lecture videos in an LMS were PA, as students could watch videos multiples times in any location; therefore, faculty's use of an LMS amplified traditional practice. Some faculty reported they used an LMS as a central hub or repository for all the course content (see Faculty 8 and 9); in these examples, the activity of using an LMS could be seen as PA, as students could access all the course content in one place anytime and anywhere. Since this could not be done with a paper form, faculty's use of an LMS amplified traditional practice.

The second common approach as to how faculty used an LMS was *communication to students*. Based on the limited brief survey responses received by participants, *communication to students* located in Passive-Replacement (PR) on the PICRAT matrix. The following quotes from different faculty members highlight the activities provided in an LMS as PR:

Faculty 10: "I posted all announcements and general communication with students" (PR).

Faculty 11: "used the Announcements feature to communicate with students" (PR).

Faculty 12: "I communicated with students via Announcements through Moodle" (PR).

Faculty 13: "Email communications were done through Blackboard" (PR).

Faculty 14: "centralized email (Canvas Conversations) to stay in touch with my students and communicate with them" (PR).

Faculty 15: "I also use Moodle to send out course emails to the entire group" (PR).

Faculty 16: "I communicated with students through the LMS Email and Announcement tools" (PR).

In these examples, faculty described the functions used in an LMS such as communication with students via the announcements and email feature are PR, as students passively received massages sent from faculty, and faculty' use of an LMS was a replacement of the traditional practice of announcing information via text or spoken word.

The third common approach as to how faculty used an LMS was to *manage assignments*. Based on the limited brief survey responses received from participants, *manage assignments* fell in Passive-Replacement (PR) and Interactive-Replacement (IR) on the PICRAT matrix. The following quotes from several faculty members highlight the activities used in an LMS as PR or IR:

Faculty 17: "I mainly used Canvas to receive student assignments throughout the semester" (PR).

Faculty 18: "have students turn assignments in on Moodle too" (PR).

Faculty 19: "used for assignment dissemination and collection" (PR).

Faculty 20: "post and receive assignments; return graded assignments" (PR).

Faculty 21: "Student also use it to do/submit short assignments" (IR, PR).

Faculty 22: "All assignments were posted to Blackboard and either done directly online in Blackboard or uploaded to Blackboard" (IR, PR).

In these examples, faculty described the activities used in an LMS, such as collecting

students' assignments or having students submit assignments, which could be PR, as

faculty simply used an LMS to replace the traditional way of students' handing in

assignments. However, some faculty did describe students directly completing

assignments in an LMS (Faculty 21 and 22); in these cases, the activities are classified as

IR, as students had to interact within the LMS.

The fourth common approach as to how faculty used an LMS was to *host quizzes/exams/tests*. Based on the limited brief survey responses received from

participants, *host quizzes/exams/tests* mapped to Interactive-Replacement (IR) on the

PICRAT matrix. The following quotes from several faculty members highlight the

activities used in an LMS as IR:

Faculty 23: "students take exams and quizzes" (IR).

Faculty 24: "I gave weekly quizzes on Moodle" (IR).

Faculty 25: "gave quizzes and exams online in Blackboard" (IR).

Faculty 26: "We have weekly quiz administered in Canvas" (IR).

Faculty 27: "the HW [homework] was posted as Moodle quizzes with randomized

numbers, and the open book/open notes exams were set up similarly while also being

chunked into smaller sections that students could tackle over a 24-hour period" (IR).

Faculty 28: "The quizzes and exams are held on Canvas together with Respondus

Monitor and Lockdown Browser" (IR).

In these examples, faculty described the activities used in a LMS such as giving students

quizzes or exams in an LMS. These instances are classified as IR, since the faculty

simply used an LMS to replace the traditional way of paper form quizzes or exams, even though students were interacting within an LMS.

The fifth common approach as to how faculty used an LMS was *grading/Gradebook*. Based on the limited brief survey responses received from participants, *grading/Gradebook* was in Passive-Replacement (PR) on the PICRAT matrix. The following quotes from several faculty members highlight the activities used in an LMS as PR:

Faculty 29: "Gradebook management" (PR).

Faculty 30: "tabulate student grades" (PR).

Faculty 31: "I used the Grades feature to grade student work" (PR).

Faculty 32: "All student grades were posted to Blackboard" (PR).

Faculty 33: "Post grades and provided feedback to students" (PR).

Faculty 34: "provide grades and feedback (including annotation on papers)" (PR).

Faculty 35: "Grading using rubrics and providing feedback is a big part of Canvas" (PR).

In these examples, faculty described the activities used in a LMS such as completing grading, posting grades, and giving feedback in an LMS can be PR, as faculty simply used an LMS to replace the traditional way of grading, providing grades, and giving feedback in paper form, and it demonstrated that using a grading feature in an LMS was not being used to improve practice.

Through the lens of the PICRAT model, the analysis suggested that faculty's main approaches of using an LMS—*host course materials*, *communication with students*, *manage assignments*, *host quizzes/exams/tests*, and *grading/Gradebook*—are mainly

located at the bottom-left corner of the PICRAT matrix. This means that faculty's uses of an LMS were more likely at the Passive-Replacement (PR) level. While some Interactive-Replacement (IR) activates and Passive-Amplification (PA) activities occurred, there were no higher-level uses of an LMS (located at the top-right corner of the PICRAT matrix, e.g., Creative-Transformation) found in this data set.

5.9 Summary

This section summarizes how faculty used an LMS based on the thematic analysis of participants' responses to the open-ended questions in the survey. The participants' responses included multiple approaches of using an LMS. The survey responses were broken down into six groups to get further comprehension of how faculty use an LMS by: 1) three LMS platforms, 2) gender, 3) age, 4) years of teaching experience, 5) years of using digital tools, and 6) years of using an LMS. Overall, faculty members indicated several common approaches of how they used an LMS: to *host course materials*, for *communication with students*, to *manage assignments*, to *host quizzes/exams/tests*, and for *grading/Gradebook*. Table 13

Summary of Results – How Faculty Use an LMS presents the summary of the three main common approaches of how faculty used an LMS across the three LMS platforms and five demographic groups.

When looking across the three LMS platforms (Moodle, Blackboard Learn, and Canvas), faculty members reported that the most common way how they used LMS was to *host course materials*. The second most and third most common approaches of how faculty members used Moodle and Canvas were mixed. Faculty members who used

142

Moodle mentioned *manage assignments* then *communication with students* as second most and third most common approaches, respectively. Canvas had a reverse in the positioning. Faculty members who used Blackboard indicated *communication with students* as second while *host quizzes/exams/tests* was the third most common approach.

When looking across faculty members' gender groups, *hosting course materials* was the most common approach as to how they used an LMS, while the second most common approach was *communication with students*. The third most common approach as to how faculty members used an LMS was mixed: male faculty members seemed more focused on using an LMS for *grading/Gradebook*, while female faculty members tended to use an LMS to *manage assignments*. Both male and female faculty members did not indicate *facilitating learning activities* as one of their common approaches of using an LMS.

When looking across faculty members' age groups, faculty members indicated that *hosting course materials* was their most common approach of using an LMS. The second most and third most common approaches of using an LMS across the age groups seemed mixed: while faculty members mentioned that they used an LMS for *communication with students* and to *manage assignments*, younger faculty members (faculty aged 40 years or younger) seemed more focused on using an LMS for *grading/Gradebook* compared to faculty members who were older. Faculty members across the three age groups did not indicate *facilitating learning activities* as one of their common approaches of using an LMS.

When looking across teaching experience groups, faculty members indicated *host course materials* as their most common approach of using an LMS. The second and third

most common approaches of using an LMS across the three teaching experience groups were mixed: while faculty members mentioned that they used an LMS for *communication with students* and to *manage assignments*, faculty members with less teaching experience (faculty with 10 or less years of teaching experience) were more focused on using an LMS for *grading/Gradebook* compared to those faculty members who had more teaching experience. Faculty members across the three groups of teaching experience did not indicate *facilitating learning activities* as one of their common approaches of using an LMS.

When looking across experience using digital tools group, faculty members indicated *host course materials* was the most common approach as to how they used an LMS. The second most and third most common approaches for using an LMS seemed mixed across the groups: while faculty members mentioned that they used an LMS for *communication with students* and to *manage assignments*, faculty members with 6 to 10 years' experience using digital tools seemed more focused on using an LMS for *grading/Gradebook* compared to other faculty members. Faculty members across the five groups of experience using digital tools did not indicate *facilitating learning activities* as one of their common approaches of using an LMS.

When looking across experience using an LMS groups, faculty members indicated *host course materials* as the most common approach as to how they used an LMS. The second and third most common approaches of using an LMS were mixed across the four groups: while faculty members mentioned that they used an LMS for *communication with students* and to *manage assignments*, faculty members with less experience of using an LMS (faculty with 3 or less years' experience using an LMS)

were more focused on using an LMS for *grading/Gradebook* compared to those faculty members who had more experience using an LMS. Faculty members across the four groups of experience using digital tools did not indicate *facilitating learning activities* as one of their common approaches of using an LMS.

To conclude, faculty members across the three LMS platforms and five demographic groups indicated *hosting course materials* as their most common approach as to how they used an LMS, while *communicating with students*, *managing assignments*, *hosting quizzes/exams/tests*, and *grading/Gradebook* were reported as one of the three common approaches as to how they used LMS. The results in this data set indicated that male faculty members and faculty members who were younger (faculty aged 40 years or younger), faculty members with less teaching experience (faculty with 10 or less years of teaching experience), and faculty members with less experience using an LMS (faculty with 3 or less years' experience using an LMS) used the grading/Gradebook feature in an LMS compared to other faculty members. The findings also indicated that *facilitating learning activities* was not one of faculty members' common approaches of using an LMS across all three LMS platforms and five demographic groups.

Through the lens of the PICRAT model, the analysis suggests that faculty's main common approaches of using an LMS: *host course materials*, *communication with students*, *manage assignments*, *host quizzes/exams/tests*, and *grading/Gradebook* are mainly located at the bottom-left corner of the PICRAT matrix. This means that faculty's uses of an LMS were more likely at the Passive-Replacement (PR) level. While faculty reported that some Interactive-Replacement (IR) activities occurred, such as *manage assignments* (quotes mentioned that students directly completed assignments in an LMS),

145

and *host quizzes/exams/tests* (quotes mentioned that students directly took quizzes/exams/tests in an LMS), there was no higher-level uses of an LMS (located at the top-right corner of the PICRAT matrix, e.g., Creative-Transformation) found in this data set.

5.10 Conclusion

There were similarities and differences in the approaches reported by faculty members according to their responses to the why and how questions about their use of an LMS. The similarity was that the most common theme was *hosting course materials* across both why and how questions. The other most common themes in both why and how questions were *communicating with students* and *managing assignments*. Faculty members did not indicate *facilitating learning activities* was one of their main reasons for why they used an LMS; nor did they indicate *facilitate learning activities* as one of the common approaches as to how they used an LMS. The main differences that emerged were that faculty members reported *hosting quizzes/exams/tests* and *grading/Gradebook* as one of the common approaches as to how they used an LMS, while they did not emphasize these two themes as one of the popular reasons for why they used an LMS.

Overall, when looking across how and why faculty used an LMS, the most common approaches reported related to curating course materials, communicating with students, and managing assignments. The findings also indicated that demographic factors like age, teaching experience, experience using digital tools, and experience using an LMS for teaching might play a minor role in influencing why and how faculty used an LMS. The results in this data set indicated that faculty who were younger, with less

146

teaching experience, less experienced using digital tools, and less experienced using an LMS for teaching were more likely to follow university policy/requirements to use an LMS and that they tended to use an LMS for grading compared to faculty members who were older, with more teaching experience, and more experience using digital tools and an LMS.

Through the lens of the PICRAT model, the analysis suggests that faculty's reasons for why and approaches to how using an LMS, regardless of demographics, are mainly located at the bottom-left corner of the PICRAT matrix. This means that faculty's uses of an LMS were more likely at the Passive-Replacement (PR) level. While faculty reported that some Interactive-Replacement (IR) and Passive-Amplification (PA) activities occurred, there was no higher-level uses of an LMS (located at the top-right corner of the PICRAT matrix, e.g., Creative-Transformation) found in this data set.

CHAPTER 6

RESULTS PART 2

6.1 Introduction

In this chapter, I present the results of two research questions: 1) What barriers influence faculty LMS use in U.S. higher education? and 2) What is the relationship between demographic factors and barriers? The chapter begins by presenting the barriers reported by faculty and discussing how they differ across the three LMS platforms and demographics.

6.2 RQ3: What Barriers Influence Faculty Use of LMS in U.S. Higher Education?

A total of 191 participants completed a section of the survey that asked about the barriers they experienced when using an LMS for instruction. This section of the survey consisted of 16 items, including 10 items of first-order barriers and six items of second-order barriers. Using a 4-point Likert scale, participants were asked to select a value that best described the barriers they encountered when they used an LMS as an instructional tool. On average, faculty reported the barriers listed were only minimally influential. However, when looking at the list, there were three first-order barriers and three second-order barriers that presented more of a challenge compared to the other barriers. In the following sections, I discuss these highly rated first-order and second-order barriers reported by faculty. A descriptive statistical analysis for each survey item of first-order and second-order barriers is presented in Table 14 and Table 15. Frequency percentages

for all survey items of first-order barriers and second-order barriers are presented in

Figure 23 and Figure 24.

Table 14

Descriptive Statistics for All Participants Responses for First-order Barriers Items

Survey item	*M*	*SD*
First-order barriers		
1. Lack of features in LMS (e.g., lack of collaborative learning tools, lack of customizable reporting)	1.1	0.9
2. Lack of time	1.0	0.9
3. Navigation issues in LMS	0.9	0.9
4. My students' motivation to use the LMS	0.8	0.9
5. Lack of professional development about how to integrate LMS into instruction	0.8	0.9
6. Hard to use across different types of devices (laptop, smartphone, tablet)	0.7	0.8
7. Lack of technical support from my institution	0.6	0.8
8. Student lack of access to the LMS	0.5	0.7
9. Student data privacy risk in LMS	0.3	0.6
10. Lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)	0.3	0.6

Table 15

Descriptive Statistics for All Participants Responses for Second-order Barrier Items

Survey item	*M*	*SD*
Second-order barriers		
1. My comfort level with figuring out how to use the LMS	0.6	0.8
2. My beliefs about how learning happens	0.6	0.9
3. My pedagogical beliefs (teaching philosophy)	0.6	0.9
4. My confidence in using the LMS for teaching	0.5	0.7
5. My motivation to use the LMS	0.5	0.8
6. My attitudes towards using LMS	0.5	0.8

Figure 23

First-order Barriers Frequency Percentage

First-order Barriers Reported by Faculty

Item	Not a Barrier	Minimal Barrier	Moderate Barrier	A Significant Barrier
1. Lack of features in LMS (e.g., lack of collaborative learning tools, lack of customizable reporting)	30.9%	36.6%	24.1%	8.4%
2. Lack of time	36.6%	32.5%	24.6%	6.3%
3. Navigation issues in LMS	40.8%	34.6%	19.4%	5.2%
4. My students' motivation to use the LMS	43.5%	31.9%	19.4%	5.2%
5. Lack of professional development about how to integrate LMS into instruction	49.7%	31.4%	12%	6.8%
6. Hard to use across different types of devices (laptop, smartphone, tablet)	48.2%	34%	15.2%	2.6%
7. Lack of technical support from my institution	52.4%	34%	10.5%	3.1%
8. Student lack of access to the LMS	56%	36.1%	6.3%	1.6%
9. Student data privacy risk in LMS	74.3%	22%	2.6%	1%
10. Lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)	80.1%	16.2%	2.1%	1.6%

■ Not a Barrier   ■ Minimal Barrier   ■ Moderate Barrier   ■ A Significant Barrier

150

Figure 24

Second-order Barriers Frequency Percentage

Second-order Barrier Frequency Percentage

	Not a Barrier	Minimal Barrier	Moderate Barrier	A Significant Barrier
1. My comfort level with figuring out how to use the LMS	56%	31.4%	8.9%	3.7%
2. My beliefs about how learning happens	61.3%	25.7%	7.3%	5.8%
3. My pedagogical beliefs (teaching philosophy)	61.8%	25.1%	7.3%	5.8%
4. My confidence in using the LMS for teaching	59.7%	32.5%	5.2%	2.6%
5. My motivation to use the LMS	66%	24.1%	5.8%	4.2%
6. My attitudes towards using LMS	66%	23.6%	4.7%	5.8%

6.2.1 The Three Most Common First-Order Barriers Reported by Faculty

Statistically, the results in this data set showed that, overall, faculty were not significantly impacted by first-order barriers. Faculty self-reported that they experienced first-order barriers as *not a barrier* to a *minimal barrier*, on average (see Table 14). However, faculty reported the three most highly rated first-order barriers that presented more of a challenge than others were: *lack of features in LMS*, *lack of time*, and *navigation issues in LMS*.

The most common first-order barrier reported by faculty, across all participants (*n* = 191), was *lack of features in LMS* (*n* = 132, 69.1%). On average, faculty rated *lack of*

151

features in LMS as a *minimal barrier* they experienced when using an LMS for instruction ($M = 1.1$, $SD = 0.9$). The data set showed 30.9% ($n = 59$) of faculty reported that *lack of features in LMS* was *not a barrier;* 36.6% ($n = 70$) as a *minimal barrier*; 24.1% ($n = 46$) as a *moderate barrier*; 8.4% ($n = 16$) as *a significant barrier* (See Figure 23). Overall, nearly 70% of faculty reported they experienced *lack of features in LMS* from a *minimal barrier to a significant barrier*, while 30.9% of faculty did not experience this barrier.

The second most common first-order barrier reported by faculty, across all participants, was *lack of time* ($n = 121$, 63.4%). On average, faculty rated *lack of time* as a *minimal barrier* they experienced when using an LMS for instruction ($M = 1.0$, $SD = 0.9$). The data set showed 36.6% ($n = 70$) of faculty reported that *lack of time* was *not a barrier;* 32.5% ($n = 62$) as a *minimal barrier*; 24.6% ($n = 47$) as a *moderate barrier*; 6.3% ($n = 12$) as *a significant barrier* (See Figure 23). Overall, around 63.4% of faculty reported they experienced *lack of time* from *a minimal barrier to a significant barrier*, while 36.6% of faculty did not experience this barrier.

The third common first-order barrier reported by faculty, across all participants, was *navigation issues in LMS* ($n = 113$, 59.2%). On average, faculty rated *navigation issues in LMS* as a *minimal barrier* they experienced when using an LMS for instruction ($M = 0.9$, $SD = 0.9$). The data set showed 40.8% ($n = 78$) of faculty reported that *navigation issues in LMS* was *not a barrier;* 34.6% ($n = 66$) as a *minimal barrier*; 19.4% ($n = 37$) as a *moderate barrier*; 5.2% ($n = 10$) as *a significant barrier* (See Figure 23). Overall, nearly 60% of faculty reported they experienced *navigation issues in LMS* from

a *minimal barrier to a significant barrier*, while 40.8% of faculty did not experience this barrier.

The results from the descriptive statistics show that the three most common first-order barriers experienced by faculty were *lack of features in LMS*, *lack of time*, and *navigation issues in LMS*. In the next section, I present the qualitative data from 15 follow-up interviews to reveal faculty's experience of these three first-order barriers.

6.2.1.1 Lack of Features in LMS

Fifteen faculty participated in the follow-up interviews, constituted by five faculty in each of the three LMS platforms: Moodle, Blackboard, and Canvas. While two faculty commented that the LMS, Canvas, satisfied what they needed, 13 faculty shared their experience of lacking features in an LMS. Based on an analysis of the interview participants' responses, faculty addressed that the common features that were lacking in an LMS were collaboration, math/programming practices, easy-to-use Gradebook features, posting formats/upload sizes, and easy-to-use interface design. The following section provides more details about each of these features.

6.2.1.1.1 Lacking Features for Real-Time Social Interaction and Collaboration

While an LMS may provide some features to support learning activities for collaboration and interaction, such as forum or discussion boards, some faculty expressed that this type of feature for collaboration was limited and that they had to use other tools to support collaborative activities. For example, Michael, a faculty from a Computer Sciences department with 7 to 9 years of experience using an LMS for teaching,

commented, "the discussion forum [in Moodle] for my purposes is not useful. And that's too bad, because then I have to send people to another website."

Alice, an early career faculty in Teacher Education with 4 to 6 years of experience using an LMS for teaching, wished Moodle could improve features "where students could collaborate in a more conceptual way" like those features in Jamboard, a digital interactive whiteboard in Google Workspace, or Flip (formerly called Flipgrid), a video-based discussion tool from Microsoft that provided more innovative and creative ways for collaboration and interaction. Alice described that she had to put in a Jamboard URL link in the Moodle course page as Jamboard provided more interactive tools that she could use with students, but students always had to leave the Moodle site to use Jamboard. She wished Moodle could at least have a feature that easily accessed Jamboard or Flip while in the Moodle site, "so they don't have to invent new software, they just have to be able to be connected and aligned to existing software that would allow us to maximally use the tools."

Other faculty also mentioned the lack of features for collaboration in LMS. Cindy, a faculty from Landscape Architecture program with 1 to 3 years of using an LMS for instruction, described that the LMS, Canvas, just did not have enough functions to support activities where students could receive immediate feedback. She said, "because I teach in design studios, how we need to have immediate feedback… sometimes you need to draw or something, you mark comments immediately and sometimes you need collaborative activities… I don't think Canvas has that kind of capacity." Because of the discipline in which she was teaching, the design field, it required immediate, real-time feedback to students when reviewing drawings and boards. Sometimes, the activities in

class could involve student collaboration, but she commented, "I think there's not enough of interaction… really happening on Canvas in the real time." She then shared that she also had to use Jamboard or Mural (an intuitive digital whiteboard for teamwork) to support collaborative activities.

Similarly, Julia, a faculty from Physics and Astronomy with over 10 years of experience using an LMS for instruction, described the collaboration feature in the LMS, Blackboard, as nonspecific, and she said, "it's not robust enough to feel natural enough for me to use it with my students." Julia commented that the Wikis feature in Blackboard was not as powerful as the Wiki she used with her research group. She described:

It doesn't seem to be aimed toward that, even though they have this thing called Blackboard Collaborate. And I know they've got things that are called Wikis and stuff like that, but it just doesn't seem to be as robust as the Wiki that I use with my research group that's being maintained by Princeton or something like that. It's a lot easier to use, or some of the other tools from other places; it's just like Blackboard has them in there by name. But if you've experienced a real Wiki, or a real collaboration thing, it's lacking, it's not rich. It's not that they don't have the feature; it's just the feature is a generic.

In these examples, faculty pointed out that features for collaboration in an LMS were there but that they were not effective and dynamic enough to meet their needs for supporting collaborative activities. This led faculty to choose to use outside tools, such as Jamboard, that provided more collaborative features.

6.2.1.1.2 Lacking Features for Programming and Math Practices

While features such as discussion forums or assessment tools (e.g., Quiz, Test) in an LMS may meet pedagogical purposes in many disciplines, faculty who taught in disciplines that involve programming and advanced math found it was difficult to use these features in an LMS, and they had to find other alternative tools that supported programming and math equations. For example, Michael commented that the discussion forum and assessments tools in Moodle were not useful when setting up programming tasks and assignments. He shared, "I cannot do certain programming specific things in them that I can do with other tools."

Faculty in disciplines that involve writing more complicated mathematical equations or formulas commented that it was very challenging to do that. For example, Lucy, who taught in Math Education with over 10 years of experience using an LMS for instruction, commented, "There is no way to write mathematics" in Canvas. Similarly, Julia also reported the difficulty of setting up numerical problems in Blackboard. She said, "I know for physics, one of the things that I really struggle with, with Blackboard is it's not set up to do numerical problems very well." This indicated that faculty needed to set up LaTeX or MathType (an equation editor) in their LMS as a solution for making advanced mathematical equations accessible for students.

Julia further highlighted the lack of an easy way to give students numerical practice problems in Blackboard. While she would like to give students self-paced, numerical problem-solving practices, the only option she could use in Blackboard was to use the Tests feature. She described:

156

There are things that I can create, that Blackboard calls it a test, but I can create a small assignment and randomize numbers, but it's very awkward, and then the students only have one attempt at it. So, we do actually use an outside homework system for the students to practice their problem solving. But I would love it if Blackboard would actually integrate that idea, that assignments aren't just, here's a link, upload your PDF when you're done. There's assignments that are inherently numeric and problem-solving and all the rest of that. And Blackboard only really has the option to, they call them tests, I call them other things when I give them to the students, but it's really set up in terms of the grading and the way it gets deployed, as a test and not just as practice.

In these examples, faculty indicated that features such as the discussion forums and assessments tools in an LMS were not useful for disciplines that require working on programming or complex mathematical equation practices. Faculty instead chose outside platforms to support their pedagogical needs.

6.2.1.1.3 Lacking an Easy-to-Use Gradebook Feature

While the Gradebook feature in an LMS could be helpful for faculty to track student performance and provide grading, the feature could be difficult to use and overwhelming. For example, Ryan, a faculty from Environmental Conversation department with 4 to 6 years of experience using an LMS for instruction, found that the Gradebook feature in Moodle was powerful and robust, but it was cumbersome as well. He said, "It's an incredibly complex system" when navigating deeper into setting up the

Gradebook. He also shared, "I would say that I struggle a little bit with the Gradebook every year; that's a little bit challenging." Another faculty, Ashley, from a History department with 4 to 6 years of experience using an LMS for teaching, shared that she first started to use Moodle because of the Gradebook feature, as she thought that was where she did the grading and that students could see how they were doing. However, she found that she had to spend quite some time to set up grading and had to have tech support explain to her how grades were calculated in the Gradebook. Ashley found that it did not make sense, and she stopped using it after a few years of trying Gradebook. She commented:

> Every time I used it, every semester I had to go in and do at least an hour, sometimes two hours' worth, of checking it with the Tech Support. Even though my grades, numerically, are very simple, on an Excel spreadsheet they're really simple formulas. But the way Moodle does grades, it's hard to understand, and if you click on the… explain the term to me, it doesn't make sense. I don't understand what it's talking about. I thought maybe it's me, but then when I talked to the Tech Support people, they had trouble explaining it also. And there was no place where I could see the formulas and be really sure that the math was accurate.

Ashley wished Moodle could just have a very basic feature like Excel spreadsheet in the Gradebook so she could be sure that the math was working properly, instead of the complex nature of the grading system that she thought was "too sort of fussy and detailed."

In these examples, faculty indicated that the Gradebook feature in Moodle could be complicated. It may require dedicating some time to understand the nature of complex grading methods in the Gradebook feature, especially if faculty wanted to follow their own methods for grading and see the calculation formulas.

6.2.1.1.4 Limitations of Posting Formats and Upload Sizes

While faculty overwhelmingly used an LMS to share course readings and videos with students, there were some limitations they experienced when they tried to post course materials. For example, Olivia, a faculty from Film Studies program with 7 to 9 years of experience using an LMS, commented that she wished she had better control of how her readings were organized in a Moodle folder. She said:

> I can organize my readings into Folders only if readings are in PDF. But if a reading is online, I can't add it to the Folder. I have to like… use a label and then… I think it's confusing, because then I can't create Folders with readings.

In this case, Olivia encountered limitations when posting different formats of files and organizing them in the same Moodle folder, as folders in Moodle only allows certain types of formats, such as PDFs, Microsoft Office documents, and images, and it does not allow URLs.

Ryan found that there were limits of video sizes he could post to his course page in Moodle. He said, "I think that there might be the one little complaints. I think when you're uploading a video, I think it's generally related to a video. If it's a certain size, Moodle is a little bit particular." He shared that he had to upload larger sizes of videos to

159

his Google Drive and then post the link of his Google Drive to his course page in Moodle, "so that students can just click on the link, and it takes them to the file versus actually having the live video in Moodle." In this case, faculty shared that there was a video upload size limit when posting a larger size of video to the course page in Moodle. Students were not able to directly see the video on the course page if a video was larger than the maximum size that Moodle allowed for posting.

In these examples, faculty indicated that there were restrictions on allowing them to post different document formats in a Moodle folder and uploading larger sizes of videos in Moodle. Faculty had to find alternative ways to organize course materials with different formats, and use other tools, such as Google Drive, to upload larger size videos.

6.2.1.1.5 Lacking Easy-to-Use User Interface Design

While most faculty in this study who used an LMS such as Moodle or Canvas did not comment that their LMS was old-fashioned, some faculty who used an older LMS, such as Blackboard Learn found that it was outdated and clunky. For example, Jessica, a faculty from a Psychology Department with over 10 years of experience using an LMS for teaching, found that Blackboard looked old-school compared to the newer LMS, Canvas, that her children were using. She said, "I think there's just some of the features seem very antiquated." She also described that some easy features, such as uploading pictures to Blackboard, seemed not as obvious as they should. She commented, "a lack of obviousness to… oh yes, we do have that feature, but you have to dig several layers down." Another faculty, Julia, had similar comments about Blackboard. She said, "you just have to click on a lot of buttons to do much in Blackboard." Similarly, Yuna, an early

career faculty from a Physical Therapy program with less than 1 year of experience using an LMS for teaching, described that Blackboard "is just not updated" if compared to newer created software and apps that have the feel of "smooth" clicking or scrolling.

Another faculty, Smith, from a Psychology Department who had used an LMS for over 10 years for teaching, commented that it was challenging to set up exams on Blackboard. He described:

> There are probably some features, some flexibility I would like to have a little bit more, it was extremely clunky to set up an exam on Blackboard… if they made it easier to set up exams on Blackboard, that would be kind of my main issue at this point, because it was very challenging.

While the older LMS, Blackboard Learn, still contained similar features of newer LMSs, faculty in the cases above described their experience that the Blackboard user interface design was outdated, clunky, and required many clicks on buttons to do one thing.

A few faculty members gave recommendations to create easier design tools for course pages and surveys. For example, Sonia, a faculty from an English Department with 4 to 6 years of experience using an LMS for instruction, recommended that Canvas could make design tools easier by providing preset formatting. She said, "having more preset formatting like Squarespace or one of the other web design sites where it has; if you put the information in, then you can have this set design for it." Another faculty, Lillian, from a School of Nursing with 4 to 6 years of experience using an LMS for instruction, who also specialized in educational evaluation, commented that the Survey feature in Blackboard was "not that conducive, not that easy… easy to design." She

wished that the Survey feature in Blackboard could be improved so that course evaluations could be designed more easily and distributed directly in Blackboard instead of using other online survey platforms which were not easy to integrate into Blackboard. In these examples, faculty described possible improvements of easier design tools for course pages and survey feature in an LMS.

In all the above cases, faculty described how they encountered missing features in an LMS, such as a lack in real-time collaboration, a lack of programming/math equation integration, a lack of flexibility to upload larger video sizes and organize different document formats in the same folder in Moodle, and a lack of easy-to use Gradebook features, course/survey templates, and user interface design. It appears the LMSs were not designed to make it easy for users because faculty struggled to figure out how to use the features, and the interfaces within the LMSs were less straightforward and intuitive. It appeared that the LMS design seems not friendly to faculty from all academic disciplines, and in many cases, features were lacking for faculty in fields that need real-time collaboration and scientific equations.

6.2.1.2 Lack of Time

During the follow-up interview, 12 faculty shared their experience of lacking time as a barrier when using an LMS for instruction. Based on analysis of the interview participants' responses, faculty addressed the common reasons for having a lack of time were due to other work commitments (such as teaching and research), as well as a lack of time to spend with tech support staff, and a lack of time to figure out and use the features

in an LMS. The following section provides more details about barriers with regards to lack of time.

6.2.1.2.1 Lack of Time Due to Other Work Commitments

Alice shared that lack of time was a *moderate barrier* to her use of Moodle for instruction. As an early career faculty, Alice dedicated her time and effort to prepare lessons and content she wanted to teach. She said, "preparing the learning management system is not the top priority. My top priority is making sure I have content delivery in a way that's very, very engaging in the classroom." She also shared, "I'm literally developing classes from scratch that my department needs me to teach, so I don't always have control over my time in that sense." Alice described that she only used functional features in Moodle that served her needs. She shared that she wanted to make an appointment with the IT department and learn more about using Moodle, but "I didn't have excess time to do that. It's been useful enough where I haven't felt I need to prioritize that, if that makes sense," she said.

Similarly, Joseph, a faculty from ESOL and Bilingual Education with less than 1 year of experience using an LMS for instruction, reported that lack of time was a *moderate barrier* to his use of Canvas in the survey. He commented that he did not have time to figure out how to do things on Canvas. He prioritized his time for planning his instruction. He said, "if I have to spend my time trying to figure out how to negotiate Canvas, then that takes away from my time planning effective instruction." In these cases, Alice and Joseph demonstrated that faculty would rather devote their time to preparing class content and instruction as the priority. This led to a lack of time to receive extra training about the features in an LMS.

163

In contrast to the faculty who devoted time for teaching, other faculty described dedicating time for doing research as the priority. Ryan, who used Moodle for his instruction, shared that it was more important to do well on his research as a faculty in an R1 university, stating that "teaching gets a little bit set aside." He said, "teaching is not really a priority for me in the sense that it's not the bigger part of my appointments. But I think it's the nature of the culture of an R1 institution." In this case, Ryan devoted time for doing research, and this led to his lack of time to prepare teaching and lack of time as well to learn more about how to use an LMS for instruction.

In these examples, faculty indicated that the barriers to dedicate time using an LMS were due to other work commitments. Because of time pressure, faculty chose to spend valuable time on preparing teaching and conducting research. Devoting time to figuring out how to use an LMS was not the priority.

6.2.1.2.2 Lack of Time to Spend with Tech Support Staff

While some faculty committed their time to teaching or doing research, a few faculty tried to dedicate additional time to get help with using an LMS from their universities, but they experienced a sense of wasting their time waiting to get assistance. Olivia, who used Moodle for her instruction, mentioned that it was a waste of time to call the staff who assisted using the LMS and wait for them to talk to her. She said:

> Because if I have to learn something new, I have to call this Media Lab and then
> wait until they talk to me. And sometimes they're incompetent and then it's just
> hours. So, I spend a lot of time just like doing that kind of work.

164

Because Olivia experienced a waste of time calling to ask for help in using an LMS, she only used features in Moodle she was already familiar with. Ashley, who used Moodle for her instruction, also experienced a waste of time for Moodle support from her university. She said, "you have to go in and wait, and wait in the waiting room; and wait until they find the person who can handle the portion of Moodle you're asking about or read a bunch of help articles."

Compared to faculty who did not devote time to figure out how to use an LMS; in these cases, Olivia and Ashley had tried to dedicate time to learn how to use an LMS but received the negative experiences of wasting time on waiting for the tech support staff to respond to them.

6.2.1.2.3 Lack of Time to Figure Out How to Use All the Features

While there are so many features provided by an LMS, it takes time to learn how to use each feature. It also requires faculty to spend time to be familiar with each individual feature, especially if they have never used the feature before. In some cases, faculty considered whether it was worth it to invest their valuable time to learn so many features in an LMS. For example, Cindy shared her concerns of investing time to learn features in Canvas, especially those features that her students were not really motivated to use. She said, "I think, to me, the time to use Canvas is an investment itself. I also will try to evaluate if I really needed this function and to learn how to use it if that's useful." For features that her students did not really like to use, such as the discussion board, Cindy expressed:

And sometimes students, they may not really use that. Just like I mentioned,

before I try to do Discussion [a feature in Canvas] and if there's no enforcement

or incentive, they may not actually do it, but just to set it up takes time too.

Cindy described that there were many features in Canvas that she had not used because "I'm not sure if I want to invest the time to learn if I don't have to." Another faculty, Sonia, also related that her LMS had too many features to learn but only limited time to devote to it. She said, "I think part of the problem is maybe that there are features available to integrate, but there's so many of them that it's hard to tell where they are and hard to learn how to incorporate all of them." In these cases, both Cindy and Sonia shared their concern about dedicating time to learn all the features in an LMS.

6.2.1.2.4 Lack of Time Due to Poor LMS Usability and User Experience

Faculty shared several critiques of wasting time on small and unimportant tech when using an LMS. Ashley, for example, described that she spent a lot of time in Moodle settings. She gave an example about spending time on adjusting a closing date for a quiz because Moodle could only show grades to students when the closing date was set. These closing date adjustments could happen many times, especially when more than one student missed the class and had to make it up or had to take a quiz at a different time. She had to change the closing date for each individual student who missed the class and quiz. Because of using Moodle to host a quiz, she had to think about the closing date adjustment, which was "things that don't really matter, but they do matter for the software." Ashley said:

I have to make an endless number of small and unimportant decisions that do nothing good for my class. Nothing good for my students. They irritate me because they take so long, and they're finicky, but if I don't do them, I can't do whatever thing it is. So, I spend a lot of time in Moodle settings. I'm constantly adjusting them.

Ashley also gave another example of writing quiz questions in Moodle that was time-consuming as it required her to do several settings for quiz questions such as timing, layout, and grade. She commented, "every function on Moodle takes time, and decision making, which involves a part of your brain that I don't want to wear out."

Julia found that it did take time "to put all the resources" together on Blackboard and "to think about how to organize it so that it's convenient for the students." She said, "putting together all the resources, and make sure they're posted, and everything's available when it's available, takes time." Another faculty, Smith, found that the version of the LMS, Blackboard, provided by his institution was a little bit clunky. It took time to put up or upload resources to the Blackboard. As a faculty who always felt there was not enough time, he commented, "why can't I just drag and drop a little bit more easily?" In these cases, faculty shared their experience of wasting time on small tech decisions, and on clunky technologies when using an LMS.

6.2.1.3 Navigation Issues in LMS

During the follow-up interview, seven faculty shared their experience of navigation issues being a barrier when using an LMS for instruction. The one common issue related to navigation was "too many clicks," which refers to the number of steps a

user must take to complete a task in an LMS. Six out of seven faculty described feeling frustrated by having to use so many clicks to set up things in the LMS. For example, Olivia and Ashley who both used Moodle for their courses mentioned "too many clicks" and "clunky." Another faculty, Alice, pointed out that she needed to be very thoughtful about where she created assignments in Moodle to avoid too many clicks if she needed to change grade points. She said:

> It doesn't let you edit the assignment in the Gradebook if you created it within a Module. You'll have to go change the grade points in the Module versus in the Gradebook. So frustrating, make it both be accessible… I shouldn't have to close out of the Gradebook, go back into the Module, then fix it there, then go back into the Gradebook, make sure I got the points right with the calculations, it's just… too many steps.

Faculty who used Blackboard also shared the similar experience of taking too many clicks to set up things in the LMS. For example, Yuna commented, "some of the features that I want, Blackboard doesn't make it that I can do it very directly or straightforward. Sometimes it takes some additional clicks to make something happen." Another faculty, Smith, commented that it required a lot of clicks when transferring information between courses. He said:

> There's just a lot of clicking to do what seems to be a very simple thing, like take this exam, this version of the exam that exists in this semester and move it to this semester that takes a lot of clicking. And creating a test or a quiz, it takes a lot of clicking.

Smith also gave another example of requiring many clicks when setting up a quiz for students with accommodations (e.g., students needing additional time). He said that he wished the LMS was able to set up another exam easier for the same students who were going to need these same accommodations. He commented:

> So instead of clicking individually for the three or four students, can I just say… make this exam be like this exam? So, every so often there's 10 or 12 clicks I have to go through when it seems like two or three should be sufficient.

Another faculty, Julia, described that setting up assignments was not very intuitive. She said, "there's a lot of buttons you have to click… So that from the faculty side, is cumbersome." She also mentioned that it took many clicks when trying to edit the same course materials used in two sections of the class. She described:

> I've got two sections that are the same material. And trying to transfer things between sections or if I'm editing something in one, and then I want to go edit the same place in the other one, it's not automatic, it's not easy. It's just… I can get there, but it's way too many clicks to have to get there.

In all the above cases, the navigational issues as barriers that faculty encountered were related to too many clicks when changing grade points, transferring the same exam to another semester, creating exams, adjusting exam settings for students with accommodations, and editing the same materials used in different class sections.

Another faculty, Jessica, experienced no back button in Blackboard as the navigational issue. She described that the version of Blackboard that her institution

supported was "stodgy" and "it almost still sits in the old school ways of doing webpages." She said:

> There's no back button, or at least it's not obvious. It's not the way it was designed… I just think sometimes it's harder to find things than it should be, which is why I spend a lot of time again on the outset making sure it's easy for my students to find my things.

In this case, Jessica found that using the old-fashioned version of the LMS, where she encountered no back button, was a navigation issue that resulted in difficulty finding things in the LMS. This led her to spend more time organizing materials to make sure students could more easily locate course materials they needed.

6.2.1.4 Summary

While participants did not report that the listed barriers posed a significant challenge in general to their use of LMS, there were still three first-order barriers that many faculty struggled with: *lack of features*, *lack of time*, and *navigation issues*. Faculty who participated in the follow-up interviews gave in-depth views of how these three first-order barriers negatively impacted their use of an LMS.

Firstly, faculty who experienced *lack of features* in an LMS described that several features were missing, including real-time interaction and collaboration options, programming, and math practice options, easy-to use Gradebook features, limited document formats and uploading sizes when posting, a lack of easy-to-use templates, and a lack of easy-to-use user interface design. This indicated that faculty experienced difficulties when accessing features in an LMS. It seems like the features provided in an

LMS did not satisfy users from all academic disciplines, especially for faculty who needed real-time collaboration, drawing/design tools, and complex scientific equations and programming features. In addition, features provided in an LMS did not seem easy to use when trying to organize different document formats in the same folder and upload larger sizes of videos. The Gradebook feature was not straightforward enough for faculty, and the course page and surveys were not easy to design in an LMS for some faculty. The findings show that user interface design for an LMS needs improvement as faculty experienced the lacking features described above.

Secondly, faculty who encountered *lack of time* as a first-order barrier commented on how they devoted time to preparing teaching content or doing research as priority; thus, leading to no additional time for preparing the LMS. Some faculty who dedicated time to trying to learn to use features in an LMS often ended up wasting time waiting for the responses from the tech staff who provided LMS assistance in their institutions. A few faculty shared their doubts and concerns on whether they should invest valuable time to master most features in an LMS, which led them to only use the features they were already familiar with. Some faculty critiqued that they took too much time on small and unimportant tech when using an LMS due to poor usability and bad user experience. This indicated that faculty who used only a few features in an LMS for instruction were impacted by a lack of time to learn all the features due to dedicating time to other priority commitments, doubts on learning all the features as it was time-consuming, poor experience of tech staff support, and bad user experience. The findings show that faculty who needed LMS assistance did not receive help in a timely manner from tech support in

their institutions. While tech support is supposed to assist faculty to solve LMS issues, the results indicated that tech support seemed to be a time waster.

Finally, many faculty who used earlier-released LMS, such as Blackboard and Moodle, experienced *navigation issues*. Faculty shared that there were "too many clicks" for setting up things in an LMS. A few faculty reported that the absence of a back button in old-fashioned LMS caused difficulty in finding or locating content when navigating the LMS. Faculty who used the newer-released LMS, Canvas, did not specifically address navigation issues in the follow-up interview data set. The findings indicated that old LMSs, such as Blackboard and Moodle, need to make improvements on usability to enhance ease-of-use interface.

Overall, based on the descriptive results of the survey responses, the participants did not report significant first-order barriers, on average, that challenged the use of LMS. This could be because most participants (74%) had over 3 years of experience using an LMS, and most participants (78%) had over 5 years of experience teaching using digital tools. The participants in this data set were considered more tech-savvy and probably had experience overcoming barriers when using an LMS compared to technology beginners who had just started to use an LMS. Another possibility is that this data was collected near the end of Spring semester, 2021, when the COVID-19 pandemic had been ongoing for longer than one year. Faculty might have already overcome most barriers integrating an LMS to support their courses during the past year, compared to the beginning of the pandemic when all the courses had to be moved to remote learning without enough time for preparation.

6.2.2 The Three Most Common Second-Order Barriers Reported by Faculty

Overall, given the low reported mean scores in this data set, faculty did not feel that second-order barriers were significant challenges to their use of an LMS. Faculty self-reported that they experienced second-order barriers as not a barrier to a minimal barrier, on average (see Table 15). However, this section covers the three most highly rated second-order barriers that influenced faculty use of LMS: *comfort with figuring out how to use the LMS*, *beliefs about how learning happens*, and *pedagogical beliefs (teaching philosophy)*.

The most common second-order barrier reported by faculty, across all participants (*n* = 191), was *comfort level with figuring out how to use the LMS* (*n* = 84, 44%). On average, faculty rated *comfort level with figuring out how to use the LMS* as a *minimal barrier* they experienced when using an LMS for instruction (*M* = 0.6, *SD* = 0.8). The data set showed 56% (*n* = 107) of faculty reported that *comfort level with figuring out how to use the LMS* was *not a barrier;* 31.4% (*n* = 60) as a *minimal barrier*; 8.9% (*n* = 17) as a *moderate barrier*; 3.7% (*n* = 7) as *a significant barrier* (See Figure 24). Overall, 44% of faculty reported they experienced *comfort level with figuring out how to use the LMS* from a *minimal barrier* to *a significant barrier*, while 56% of faculty did not experience this barrier.

The second most common second-order barrier reported by faculty, across all participants (*n* = 191), was *beliefs about how learning happens* (*n* = 74, 38.7%). On average, faculty rated *beliefs about how learning happens* as a *minimal barrier* they experienced when using an LMS for instruction (*M* = 0.6, *SD* = 0.9). The data set showed *61.3% (n* = 117) of faculty reported that *beliefs about how learning happens* was *not a*

barrier; 25.7% (*n* = 49) as a *minimal barrier*; 7.3% (*n* = 14) as a *moderate barrier*; 5.8% (*n* = 11) as *a significant barrier* (See Figure 24). Overall, 38.7% of faculty reported they experienced *beliefs about how learning happens* from a *minimal barrier* to *a significant barrier*, while 61.3% of faculty did not experience this barrier.

The third most common second-order barrier reported by faculty, across all participants, was *pedagogical beliefs (teaching philosophy)* (*n* = 73, 38.2%). On average, faculty rated *pedagogical beliefs (teaching philosophy)* as a *minimal barrier* they experienced when using an LMS for instruction (*M* = 0.6, *SD* = 0.9). The data set showed 61.8% *(n* = 118) of faculty reported that *pedagogical beliefs (teaching philosophy)* was *not a barrier;* 25.1% (*n* = 48) as a *minimal barrier*; 7.3% (*n* = 14) as a *moderate barrier*; 5.8% (*n* = 11) as *a significant barrier* (See Figure 24). Overall, 38.2% of faculty reported they experienced *pedagogical beliefs (teaching philosophy)* from a *minimal barrier* to *a significant barrier*, while 61.8% of faculty did not experience this barrier.

Overall, the results in this data set showed that faculty self-reported that they experienced second-order barriers as *not a barrier* to a *minimal barrier*, on average. The three highest rated second-order barriers experienced by faculty were: *comfort level with figuring out how to use the LMS, beliefs about how learning happens, and pedagogical beliefs (teaching philosophy)*. In the next section, I present the qualitative data from 15 follow-up interviews to reveal the faculty's experience of these three second-order barriers.

6.2.2.1 Comfort with Figuring Out How to Use the LMS

During the follow-up interview, three faculty shared their experience of figuring

out how to use an LMS. Of the three faculty who rated it a second-order *moderate*

barrier, two faculty were early in their careers. For example, Alice, with 4 to 6 years of

experience using an LMS, described that she was missing features in Moodle, and she did

not know what she was missing. She said, "it's been a developmental progress for me to

make it more functional for myself." Alice shared that there were many things that she

did not know how to do, such as "more aesthetically unique, design wise" in the modules,

but she was going to keep using Moodle until she got to a point. She expressed, "but

Moodle has, I think, done 50% of that work for us. And I think they could have done

more like 75% of the work and made the rest fall on us." In this case, Alice wished

Moodle could be more intuitive to use. Through this example, faculty were comfortable

to try features in an LMS, but their comfort with figuring out how to use features in an

LMS may have been negatively impacted by poor intuitive interface and design.

Another early career professor, Caroline, who had less than 1 year of experience

using an LMS, explained that she would take the time to learn things, but there were

many things that took her quite a while to figure out. For example, she took a couple of

hours to learn video editing, and she found that the period of editing a video to publishing

it in Canvas took a long time. Because faculty are busy and their time is valuable, this

experience led her to keep doing things the way she knew how to do them instead of

investing time to learn a new way. She said, "there's also things that if I know how to do

it another way, I'll just do it a different way instead of trying to learn something new in

Canvas." She gave an example of how, when she typed mathematical equations into the

quizzes in Canvas, she would just type the symbol caret (^) instead of trying to figure out how to format a superscript for a unit. Caroline's example showed that she was comfortable figuring out a new technology integration, but she seemed unwilling if it required time investment. This case indicated that faculty's willingness to change and the comfort level of figuring out how to use a new thing in an LMS might be intertwined with the first-order barrier of time.

The third faculty, Olivia, with 7 to 9 years of experience using Moodle, commented that she was fine to just search online herself and figure out how to use Moodle. She said, "if I find an answer and then it' great. If I can't find an answer, then I have to go through like this Media Lab and wait on Zoom, so that's not great. So that's why it's moderate [barrier]." This case indicated that Olivia was comfortable to figure out how to use an LMS by searching solutions online herself; however, if she was not able to figure out answers herself and had to ask help from the Moodle support staff in her institution, she did not seem comfortable with that as it would waste her time just waiting for responses from support staff. This case indicated that faculty's comfort level of figuring out how to use an LMS might be intertwined with the first-order barrier of time.

In these examples, faculty demonstrated that they were comfortable and willing to figure out how to use an LMS. However, factors from first-order barriers such as lack of intuitive interface in an LMS and time devoted seemed to play a role in faculty's comfort level in figuring out how to use an LMS.

6.2.2.2 Beliefs About How Learning Happens

176

During the follow-up interview, seven faculty shared how their beliefs about how learning happens influences their use of an LMS as a barrier. Three out of seven faculty's beliefs about how individuals acquire knowledge were associated to social constructivism, while the other four faculty's beliefs about learning were related to behaviorism. In terms of social constructivism, faculty believe that learning happens through interaction with others. For example, Ashley, a faculty from a History Department, reported it was *a significant barrier* for her to use Moodle as she believed that learning happened through in-person discussion. She said, "different students' minds work in different ways, so I want to address as many as I can. But a lot of that involves the in-person in the class discussion." Ashley commented that Moodle was great for shy students who don't like to talk out loud. However, Moodle did not provide her with very much that was helpful, as her class was relying on in-class in-person discussion.

Another faculty, Julia, a faculty from the Physics and Astronomy Department, reported that it was a *moderate barrier* for her to use Blackboard, as she said, "I believe that learning happens interactively and not in isolation." She felt that students were more isolated from each other when they were on Blackboard. The other faculty, Lucy, a faculty from a Math Education Department, reported that it was a *minimal barrier* for her to use Canvas, though she believed that learning happened through constructing understanding. She said, "I believe that students construct their understanding, which means I have to talk to them." She further explained, "You can't do that on Canvas. You can't have a task set up [on Canvas], where they can talk to each other or interact, if you're constructing your understanding." In these three cases, faculty's beliefs about how learning happens leaned towards social constructivism, as faculty described how learning

177

occurs through in-person discussion and interaction with others. Sadly, based on faculty's experience, LMS does not provide enough support or features for facilitating interactive discussion.

In terms of behaviorists, faculty believe that learning occurs through repetitive practice. For example, Michael, a faculty from the Computer Sciences Department, reported that it was *a significant barrier* for him to use Moodle, as he described that learning programming required practice, but Moodle did not provide this feature. He said:

> That's a very hands-on, that's a very applied kind of skill. It's not the kind of skill you generally develop by answering multiple choice questions, or even short answer questions. It might be, you get some of it by reading and analyzing, for sure. But some of it, you also get by doing or by correcting mistakes that you make or that sort of thing. And so, it really requires practice in a way that the Moodle anyway, does not facilitate.

In this case, Michael pointed out that Moodle was lacking a feature to facilitate practice for learning programming.

Three faculty reported that it was just a *minimal barrier* to using an LMS because the LMS features aligned with the way they taught, through behaviorist approaches. For example, Jessica, a faculty from a Psychology Department, described that her beliefs about how learning happened were based on cognitive psychology. She said, "So practice, practice, practice, practice, practice. If you show up, if you engage, and if you care about it." She thought Blackboard was useful as she uploaded class notes and videos, and students were able to access these course materials in the LMS. She described, "So,

Blackboard does allow me to provide them that, and provide them with opportunities to

rehearse and to reengage… If you practice, and if you've been engaged in class, then I

think learning does, hopefully, happen."

Another faculty, Ryan, from an Environmental Conversation Department,

described, "in my opinion, learning happens through experience, through repetition. It

happens through the development of skills, the development of knowledge." He

explained that Moodle was useful in that he could upload further readings or videos to

provide students with extra resources other than his lecture time in class. He then said,

"And then the repetition, again, that's kind of more… I guess there's a little bit of

repetition when you're reading something in a text and taking a quiz about it."

Another faculty, Sonia, from an English Department, described, "I think it's

something that happens over time, letting things go and bringing them back and letting

things go and bringing them back again." She commented:

> I think it's good to have the rubrics that I can use over different assignments to
>
> say, "Yes, these are the skills that we're testing. We work on them here, and then
>
> we work on them again in this part too."

In the four cases above, faculty believed that learning happens through knowledge

acquiring, practice, and repetition. While Michael commented that Moodle did not

provide the feature that was helpful in his discipline, the other three faculty seemed

satisfied with using the LMS to support their instruction as they tended to use features

such as uploading course materials, hosting quizzes, or creating rubrics in LMS, which

supported the behaviorist approach.

6.2.2.3 Pedagogical Beliefs (Teaching Philosophy)

During the follow-up interview, seven faculty shared their pedagogical beliefs and how their pedagogical beliefs influenced their use of an LMS as a barrier. Two out of seven faculty described it as *a significant barrier*, one faculty described it as a *moderate barrier*, and the other four faculty reported it as a *minimal barrier*.

Michael reported it as *a significant barrier* towards using Moodle. He described his pedagogical belief was more geared towards "group work." He commented that there were a variety of options for doing assessments, either formative or summative, in Moodle. He said, "But ultimately, it comes down to check boxes and filling in text boxes." Michael explained that he would rather be doing in-person group activities instead of driving student engagement towards the computer. Although he was a computer scientist, he said, "I would rather have them engaged sort of a broader kind of way of thinking than kind of get through this, get through this... It's very dehumanizing. And so that's my core objection."

Similarly, Ashley also reported that it was *a significant barrier* for her to use Moodle. She described how her pedagogical belief was more geared towards "interactive learning." While she found that she had no problem interacting with her students, there was a barrier when considering how to design the format of questions in Moodle so that her students would participate and respond in the way she wanted. She said:

> A lot of the interaction with my students' minds I can do basically anywhere, so Moodle is irrelevant. What is more important is not the format of the question. Is it a quiz? Is it a chat? It doesn't matter. What matters is the question, and is the

question designed to get from them whatever thought I'm hoping that they'll produce.

She explained how Moodle could not be set up in a way that would allow her to design the type of questions she wanted to ask when using the online quizzes feature. She said, "I had to change what I was asking in order to use the Moodle function, which I did not appreciate." In the two cases above, faculty reported significant barriers because there were limited features in an LMS to support "collaborative" and "interactive" pedagogical approaches.

Sonia reported that it was a *moderate barrier* to use Canvas. She described her pedagogical belief was more geared towards "cognitive learning." She said:

I like to focus on introducing core concepts for the discipline and giving students an opportunity to apply things in their own words and with their own examples. Because I think that helps them retain the core concepts a lot better than just learning the concept in my example.

Sonia described that she used the discussion threads in Canvas for students to work out their own responses and reflections; this was kind of important to her teaching philosophy. In this case, Sonia demonstrated that she used the discussion thread feature in Canvas to support her pedagogical belief.

Julia described her pedagogical belief as "knowledge sharing and social learning." She reported that it was a *minimal barrier* for her to use Blackboard. She said:

It's about the students interacting with the content, and them becoming comfortable with their understanding of the material and really thinking about

181

what's working for me and what's not working for me… To start recognizing

their own strengths and weaknesses, and really to get the students to interact with

each other so that they can use their strengths to help their classmates, and their

classmates can use their different strengths to help them so that we all engage in

learning as an active technique.

Julia described Blackboard as a platform that helped her to provide resources to students. She also used discussion boards and journals to keep students engaged with the content. However, when it came to students interacting in classroom and helping each other out, Blackboard was not able to replicate that. In this example, Julia only used features in an LMS for the purpose of providing students with course resources, but she also implied that the LMS was not able to support pedagogy that requires social interaction.

Jessica described her pedagogical belief as "student engagement." She reported that it was a *minimal barrier* to use Blackboard. She described that if it was a content-heavy course, she could use Blackboard to provide course content. However, if she wanted student engagement, Blackboard was not that helpful. She would rather be face-to-face with students instead of using the discussion board feature in Blackboard. Jessica said, "I can give them the content, I can give them the information, but I can't really engage them in ways that lend themselves to how I like to teach." In these two cases, Julia and Jessica expressed that the LMS served as a platform to provide student course content. However, when it came to student social interaction and student engagement, the features were limited in Blackboard.

Similarly, Smith, a faculty from a Psychology Department, described how his pedagogical belief was focused on "engaging with students," and that he did not have a high expectation for using Blackboard to apply his pedagogy. He reported that it was just a *minimal barrier* for him to use Blackboard. He said:

I don't expect the LMS to do anything more and not anything less than what it's designed to do. So, I like engaging with my students. I like doing hands on activities. I like doing demos in class… And I don't expect to be able to do that in the LMS, so I don't. So, I just expect the LMS to do the simple things of providing, of being a 24-hour, 24/7 access for students… And I don't expect the LMS to be able to provide experiences like that to the student because that's what class is for. So, I guess I have low expectations for the LMS, and the LMS meets those low expectations.

In this example, Smith demonstrated that he was not expecting his LMS use to correspond to his pedagogical beliefs as he did not have high expectations for the LMS. He was not disappointed in what the LMS could offer, as he only expected the LMS to provide basic functions in his class, such as providing course material to students whenever they needed.

Joseph, a faculty from ESOL and the Bilingual Education Department, reported that it was just a *minimal barrier* for him to use Canvas. He described his pedagogical belief as "student-centered" and stated that the LMS was very student friendly as students could keep track of their grades and discuss and interact with each other. He pointed out there was a debate between online versus face-to-face instruction, as people had strong

183

beliefs about face-to-face instruction and usually felt that online instruction was distant

and believed that "you can't embrace students." through an LMS. Joseph said:

> I don't feel that way at all. I feel that I can personalize my instruction through
>
> Canvas. I feel like I said, by showing my face by, by making a variety of different
>
> choices, students can use to fulfill the objections to the module. It's organized in a
>
> way that's very student friendly.

In this case, Joseph demonstrated that using the LMS for instruction did not necessarily

cause a disconnect from students. With good plans and well-organized course modules,

the LMS could be student friendly, which reflected his pedagogical beliefs.

In each of these examples, faculty described their different pedagogical beliefs.

Many faculty focused on student engagement and student interaction, while a few faculty

emphasized a cognitive or student-centered approach. Only two faculty experienced

significant barriers because the features they used in an LMS did not support their

pedagogical beliefs. However, four faculty reported that it was only a *minimal barrier*,

although the LMS did not meet their pedagogical approaches. The findings indicated that

faculty who experienced it as a *minimal barrier* seemed to understand that the LMS had

its limitations when supporting their pedagogical beliefs. They tended to only use its

features to serve basic teaching functions, such as providing course content materials, and

maintaining a limited level of student engagement via the use of discussion boards.

6.2.2.4 Summary

While participants did not report that the listed barriers posed a significant

challenge to their LMS use in general, there were still three second-order barriers that

many faculty, on average, struggled with: *comfort with figuring out how to use the LMS*, *beliefs about how learning happens*, and *pedagogical beliefs (teaching philosophy)*. Faculty who participated in the follow-up interviews gave in-depth views of how these three second-order barriers impacted how they used an LMS.

First, the cases from the follow-up interviews indicated that faculty felt comfortable figuring out how to use features in an LMS; however, faculty's willingness to change to use new features and to learn how to use new features in an LMS seemed impacted by the first-order barriers of time and intuitive interface. The finding suggested the faculty's intrinsic barrier; their *comfort level figuring out how to use an LMS* might be influenced by extrinsic first-order barriers.

Second, faculty's beliefs about how learning happens could be categorized into two major learning theories: social constructivism and behaviorism. The findings indicated that faculty who believed learning happened through social interaction (social constructivism) found that the features in an LMS could not replace in-person interaction. Faculty who believed that learning occurred through practice and repetition (behaviorism) were likely to report that their barrier was minimal, because they found the features in an LMS, such as using the quizzes feature, to satisfy their instructional techniques and to reinforce learning.

Finally, faculty's pedagogical beliefs (teaching philosophy) influenced how they applied features in an LMS for their instruction. The findings indicated that faculty tended to use the features in an LMS that corresponded to their pedagogical beliefs. For example, faculty who did not have a high expectation of what an LMS could do and who believed that they had the responsibility to, at the minimum, provide for students'

learning resources, found that the LMS accomplished the job well, as they uploaded course materials to the LMS. However, if faculty's pedagogical beliefs tended towards collaboration, interaction, and student engagement, they found the features in an LMS to be limited. The faculty whose pedagogical belief was student-centered found that the LMS could be student-friendly with well-planned and organized course modules.

The findings in this data set indicated that there seemed to be a significant overlap between first-order and second-order barriers. First, the intrinsic barrier of comfort with figuring out how to use an LMS tended to be negatively influenced by extrinsic first-order barriers, such as lack of time, poor technical support, and poor interface design. Second, faculty's beliefs about how learning happens (learning theories) were affected by their comments about the first-order barrier of lack of features, as faculty were more likely to use features that aligned to the learning theories they applied in their instruction. Similarly, faculty's teaching philosophy influenced what features they chose to use and how they used the features; this also impacted their comments about the first-order barrier of lack of features. Overall, the findings indicated that first-order and second-order barriers can both hinder faculty's LMS use, and that, first-order and second-order barriers are often intertwined.

6.3 RQ3a: What is the Relationship Between Demographic Factors and Barriers?

In this section, I present the statistical results that answered RQ3a: "What is the relationship between the demographic factors and barriers?" I analyzed the data through rank-based non-parametric tests, Mann-Whitney U tests and Kruskal-Wallis H tests, to identify if demographic factors influenced first-order and second-order barriers. The

statistical analysis represented whether each first-order and second-order barrier, when measured on an ordinal scale, differed based on demographic information.

6.3.1 LMS Platforms and Barriers to Technology Integration

I conducted 16 Kruskal-Wallis H tests to determine if there were differences in the identification of significant barriers between the three groups of LMS platforms used by faculty members. The ordinal dependent variables included 10 first-order barriers survey items and six second-order barriers survey items measured on a 4-point Likert scale from *not a barrier* to *a significant barrier*, and the independent variable was LMS platforms, which had three groups: Moodle ($n = 63$), Blackboard Learn ($n = 62$), and Canvas ($n = 66$). The level of significance was set at .05. The results indicated that the mean rank of 16 barriers scores were not statistically significantly different among the three LMS platforms groups. Table 16 presents the Kruskal-Wallis H tests results for 16 barriers items in the survey by the three LMS platform groups.

Table 16

Kruskal-Wallis H Tests Results for Barriers to Technology Integration Based on LMS Platforms

Variables (survey items)	Group	n	Mean rank	$\chi2$	df	p
First-order barriers						
1. Lack of time	Moodle	63	101.45	1.049	2	.592
	Blackboard Learn	62	92.43			
	Canvas	66	94.15			
2. Lack of technical support from my institution	Moodle	63	102.18	1.441	2	.486
	Blackboard Learn	62	92.98			
	Canvas	66	92.94			
3. Lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)	Moodle	63	96.82	.846	2	.655
	Blackboard Learn	62	98.73			
	Canvas	66	92.65			
4. Student lack of access to LMS	Moodle	63	96.56	.391	2	.822
	Blackboard Learn	62	92.99			

		N	Mean Rank			
	Canvas	66	98.30			
5. Hard to use across different types of devices (laptop, smartphone, tablet)	Moodle	63	97.09	.619	2	.734
	Blackboard Learn	62	98.98			
	Canvas	66	92.16			
6. Student data privacy risk in LMS	Moodle	63	93.40	3.842	2	.146
	Blackboard Learn	62	90.12			
	Canvas	66	104.00			
7. Navigation issues in LMS	Moodle	63	101.47	1.588	2	.452
	Blackboard Learn	62	89.81			
	Canvas	66	96.60			
First-order barriers						
9. Lack of professional development about how to integrate LMS into instruction	Moodle	63	105.40	3.250	2	.197
	Blackboard Learn	62	92.19			
	Canvas	66	90.61			
10. My students' motivation to use the LMS	Moodle	63	101.68	2.688	2	.261
	Blackboard Learn	62	99.10			
	Canvas	66	87.67			
Second-order barriers						
11. My comfort level with figuring out how to use the LMS	Moodle	63	100.36	.816	2	.665
	Blackboard Learn	62	92.60			
	Canvas	66	95.04			
12. My confidence in using the LMS for teaching	Moodle	63	95.77	.272	2	.873
	Blackboard Learn	62	98.39			
	Canvas	66	93.98			
13. My motivation to use the LMS	Moodle	63	94.13	1.520	2	.468
	Blackboard Learn	62	101.85			
	Canvas	66	92.30			
14. My pedagogical beliefs (teaching philosophy)	Moodle	63	93.88	.933	2	.627
	Blackboard Learn	62	100.81			
	Canvas	66	93.50			
15. My beliefs about how learning happens	Moodle	63	92.60	.491	2	.782
	Blackboard Learn	62	97.10			
	Canvas	66	98.22			
16. My attitudes towards using LMS	Moodle	63	97.33	3.197	2	.202
	Blackboard Learn	62	102.79			
	Canvas	66	88.35			

6.3.2 Gender and Barriers to Technology Integration

I conducted 16 Mann-Whitney U tests to determine if there were differences in the identification of significant barriers between male and female faculty members. The ordinal dependent variables included 10 first-order barriers survey items and six second-order barriers survey items measured on a 4-point Likert scale from *not a barrier* to *a significant barrier*, and the independent variable was gender, which had two groups: male

($n = 66$), and female ($n = 125$). The level of significance was set at .05. The results

indicated that the 16 barriers scores were not statistically significantly different between

male and female faculty members. Table 17 presents the Mann-Whitney U tests results

for 16 barriers items in the survey by gender of faculty members.

Table 17

Mann-Whitney U Tests Results for Barriers to Technology Integration Based on Gender

Dependent variables (survey items)	Group	n	Mean rank	U	z	p
First-order barriers						
1. Lack of time	Male	66	100.90	3801.5	-.938	.348
	Female	125	93.41			
2. Lack of technical support from my institution	Man	66	96.08	4119.5	-.017	.987
	Female	125	95.96			
3. Lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)	Male	66	94.68	4212.0	.345	.730
	Female	125	96.70			
4. Student lack of access to the LMS	Male	66	97.18	4047.0	-.244	.808
	Female	125	95.38			
5. Hard to use across different types of devices (laptop, smartphone, tablet)	Male	66	97.19	4046.5	-.235	.814
	Female	125	95.37			
6. Student data privacy risk in LMS	Male	66	98.12	3985.0	-.507	.612
	Female	125	94.88			
7. Navigation issues in LMS	Male	66	88.18	4641.0	1.511	.131
	Female	125	100.13			
8. Lack of features in LMS (e.g., lack of collaborative learning tools, lack of customizable reporting)	Male	66	87.18	4707.0	1.682	.093
	Female	125	100.66			
9. Lack of professional development about how to integrate LMS into instruction	Male	66	95.39	4165.5	.121	.903
	Female	125	96.32			
10. My students' motivation to use the LMS	Male	66	99.67	3882.5	-.712	.476
	Female	125	94.06			
Second-order barriers						
11. My comfort level with figuring out how to use the LMS	Male	66	99.11	3919.5	-.635	.525
	Female	125	94.36			
12. My confidence in using the LMS for teaching	Male	66	98.58	3955.0	-.539	.590
	Female	125	94.64			

189

13. My motivation to use the LMS	Male	66	94.03	4255.0	.428	.669
	Female	125	97.04			
14. My pedagogical beliefs (teaching philosophy)	Male	66	97.71	4012.0	-.360	.719
	Female	125	95.10			
15. My beliefs about how learning happens	Male	66	97.80	4006.5	-.376	.707
	Female	125	95.05			
16. My attitude towards using LMS	Male	66	95.88	4133.0	.026	.979
	Female	125	96.06			

6.3.3 Age and Barriers to Technology Integration

I conducted 16 Kruskal-Wallis H tests to determine if there were differences in the identification of significant barriers among three groups of faculty members' age. The ordinal dependent variables included 10 first-order barriers survey items and six second-order barriers survey items measured on a 4-point Likert scale from *not a barrier* to *a significant barrier*, and the independent variable was age, which had three groups: ≤ 40 years old ($n = 71$), 41–49 years old ($n = 60$), and 50+ years old ($n = 60$). The level of significance was set at .05.

The results indicated that the mean ranks of the first-order barrier *hard to use across different types of devices (laptop, smartphone, tablet)* scores were statistically significantly different among groups, $\chi^2(2) = 7.327$, $p = .026$. Subsequently, I performed pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted *p*-values are presented. This post hoc analysis revealed a statistically significant difference in the first-order barrier *hard to use across different types of devices (laptop, smartphone, tablet)* scores between the 41–49 years old (mean rank = 84.21) and ≤ 40 years old (mean rank = 108.01) ($p = .023$) groups, but not between any other group combination. Table 18 presents the Kruskal-Wallis H tests

190

results for 16 barriers items in the survey by three different age groups of faculty

members.

Table 18

Kruskal-Wallis H Tests Results for Barriers to Technology Integration Based on Age

Variables (survey items)	Group	*n*	Mean rank	$\chi 2$	df	*p*
First-order barriers						
1. Lack of time	≤ 40 years old	71	101.68	2.020	2	.364
	41–49 years old	60	96.63			
	50+ years old	60	88.64			
2. Lack of technical support from my institution	≤ 40 years old	71	96.36	2.322	2	.313
	41–49 years old	60	102.73			
	50+ years old	60	88.85			
3. Lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)	≤ 40 years old	71	97.23	1.138	2	.566
	41–49 years old	60	98.82			
	50+ years old	60	91.73			
4. Student lack of access to the LMS	≤ 40 years old	71	97.20	.410	2	.815
	41–49 years old	60	97.89			
	50+ years old	60	92.69			
5. Hard to use across different types of devices (laptop, smartphone, tablet)	≤ 40 years old	71	108.01	7.327	2	.026*
	41–49 years old	60	84.21			
	50+ years old	60	93.58			
6. Student data privacy risk in LMS	≤ 40 years old	71	94.95	1.387	2	.500
	41–49 years old	60	101.03			
	50+ years old	60	92.22			
7. Navigation issues in LMS	≤ 40 years old	71	99.27	2.230	2	.328
	41–49 years old	60	100.40			
	50+ years old	60	87.73			
8. Lack of features in LMS (e.g., lack of collaborative learning tools, lack of customizable reporting)	≤ 40 years old	71	102.06	3.619	2	.164
	41–49 years old	60	99.41			
	50+ years old	60	85.42			
9. Lack of professional development about how to integrate LMS into instruction	≤ 40 years old	71	97.76	.868	2	.648
	41–49 years old	60	98.93			
	50+ years old	60	90.99			
10. My students' motivation to use the LMS	≤ 40 years old	71	100.75	1.037	2	.596
	41–49 years old	60	91.79			
	50+ years old	60	94.59			
11. My comfort level with figuring out how to use the LMS	≤ 40 years old	71	98.11	.625	2	.732
	41–49 years old	60	91.85			
	50+ years old	60	97.66			
12. My confidence in using the LMS for teaching	≤ 40 years old	71	99.79	.780	2	.677
	41–49 years old	60	94.96			
	50+ years old	60	92.56			
13. My motivation to use the LMS	≤ 40 years old	71	98.06	3.439	2	.179
	41–49 years old	60	102.34			
	50+ years old	60	87.22			
14. My pedagogical beliefs (teaching philosophy)	≤ 40 years old	71	96.57	.449	2	.799
	41–49 years old	60	98.53			

191

	50+ years old	60	92.79			
15. My beliefs about how learning happens	≤ 40 years old	71	98.93	.920	2	.631
	41–49 years old	60	97.36			
	50+ years old	60	91.18			
16. My attitudes towards using LMS	≤ 40 years old	71	96.97	2.133	2	.344
	41–49 years old	60	101.52			
	50+ years old	60	89.33			

*p = <.05

6.3.4 Years of Teaching Experience and Barriers to Technology Integration

I conducted 16 Kruskal-Wallis H tests to determine if there were differences in the identification of significant barriers among three groups of faculty members' teaching experience. The ordinal dependent variables included 10 first-order barriers survey items and six second-order barriers survey items measured on a 4-point Likert scale from *not a barrier* to *a significant barrier*, and the independent variable was years of teaching experience, which has three groups: ≤ 10 years (*n* = 76), 11–20 years (*n* = 58), and 20+ years (*n* = 57). The level of significance was set at .05.

The results indicated that the mean ranks of the first-order barrier "*hard to use across different types of devices (laptop, smartphone, tablet)*" scores were statistically significantly different among groups, $\chi^2(2) = 8.170$, *p* = .017. Subsequently, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted *p*-values are presented. This post hoc analysis revealed a statistically significant difference in the first-order barrier *hard to use across different types of devices (laptop, smartphone, tablet)* scores between the 11–20 years' teaching experience (mean rank = 85.20) and ≤ 10 years' teaching experience (mean rank = 108.72, *p* = .024), but not between any other group combination. Table 19 presents the Kruskal-Wallis H tests results for 16 barriers items in the survey by three different teaching experience groups of faculty members.

192

Table 19

Kruskal-Wallis H Tests Results for Barriers to Technology Integration Based on Years of

Teaching Experience

Variables (survey items)	Group	*n*	Mean rank	χ2	df	*p*
First-order barriers						
1. Lack of time	≤ 10 years	76	97.80	1.383	2	.501
	11–20 years	58	100.20			
	20+ years	57	89.32			
2. Lack of technical support from my institution	≤ 10 years	76	93.90	.880	2	.644
	11–20 years	58	101.13			
	20+ years	57	93.58			
3. Lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)	≤ 10 years	76	98.59	.930	2	.628
	11–20 years	58	96.40			
	20+ years	57	92.14			
4. Student lack of access to the LMS	≤ 10 years	76	100.77	2.761	2	.252
	11–10 years	58	98.46			
	20+ years	57	87.14			
5. Hard to use across different types of devices (laptop, smartphone, tablet)	≤ 10 years	76	108.72	8.170	2	.017*
	11–20 years	58	85.20			
	20+ years	57	90.03			
6. Student data privacy risk in LMS	≤ 10 years	76	95.83	.385	2	.825
	11–20 years	58	93.71			
	20+ years	57	98.56			
7. Navigation issues in LMS	≤ 10 years	76	102.05	2.219	2	.330
	11–20 years	58	95.43			
	20+ years	57	88.52			
8. Lack of features in LMS (e.g., lack of collaborative learning tools, lack of customizable reporting)	≤ 10 years	76	102.21	2.895	2	.235
	11–20 years	58	97.09			
	20+ years	57	86.61			
9. Lack of professional development about how to integrate LMS into instruction	≤ 10 years	76	100.20	.970	2	.616
	11–20 years	58	94.74			
	20+ years	57	91.68			
10. My students' motivation to use the LMS	≤ 10 years	76	95.62	.149	2	.928
	11–20 years	58	98.06			
	20+ years	57	94.41			
Second-order barriers						
11. My comfort level with figuring out how to use the LMS	≤ 10 years	76	95.80	.139	2	.933
	11–20 years	58	97.82			
	20+ years	57	94.42			
12. My confidence in using the LMS for teaching	≤10 years	76	98.74	.658	2	.720
	11–20 years	58	96.40			
	20+ years	57	91.95			
13. My motivation to use the LMS	≤ 10 years	76	99.69	.848	2	.654
	11–20 years	58	94.45			
	20+ years	57	92.66			
14. My pedagogical beliefs (teaching philosophy)	≤ 10 years	76	96.02	.000	2	1.000
	11–20 years	58	95.97			
	20+ years	57	96.00			
15. My beliefs about how learning happens	≤ 10 years	76	98.17	.331	2	.847
	11–20 years	58	93.37			

	20+ years	57	95.78			
16. My attitudes towards using LMS	≤ 10 years	76	99.49	.722	2	.697
	11–20 years	58	93.52			
	20+ years	57	93.87			

*p = <.05

6.3.5 Years of Using Digital Tools for Teaching and Barriers to Technology Integration

I conducted 16 Kruskal-Wallis H tests to determine if there were differences in the identification of significant barriers among five groups of faculty members' years of using digital tools for teaching. The ordinal dependent variables included 10 first-order barriers survey items and six second-order barriers survey items measured on a 4-point Likert scale from *not a barrier* to *a significant barrier*, and the independent variable was years of using digital tools for teaching, which had five groups: ≤ 5 years ($n = 42$), 6–10 years ($n = 43$), 11–15 years ($n = 44$), 16–20 years ($n = 33$), and 20+ years ($n = 29$). The level of significance was set at .05.

The analysis showed four statistically significant findings. First, the results indicated that the mean ranks of the first-order barrier *lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)* scores were statistically significantly different among groups, $\chi^2(4) = 9.631$, $p = .047$. Subsequently, I compared pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted *p*-values are presented. This post hoc analysis revealed that none of pairwise tests of mean rank difference were statistically significant after controlling for multiple testing. Therefore, the post hoc tests were not able to identify the significant difference between the groups. The possible reasons to explain the lack of statistical significance between the groups are: 1) The Kruskal-Wallis H tests were only

194

barely significant ($p = .047$), and 2) there were many levels in groups to compare. These results indicate two possibilities: 1) the global test was a false positive finding, or 2) the post hoc analysis was low power.

Second, the results indicated that the mean ranks of the first-order barrier *navigation issues in LMS* scores were statistically significantly different among groups, $\chi^2(4) = 10.645$, $p = .031$. Subsequently, I performed pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted *p*-values are presented. This post hoc analysis revealed statistically significant difference in the first-order barrier *navigation issues in LMS* scores between the 20+ years of experience using digital tools (mean rank = 74.72) and ≤ 5 years of experience using digital tools (mean rank = 110.93, $p = .039$), but not between any other group combination.

Third, the results indicated that the mean ranks of the first-order barrier *lack of features in LMS* scores were statistically significantly different among groups, $\chi^2(4) = 14.121$, $p = .007$. Subsequently, I performed pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted *p*-values are presented. This post hoc analysis revealed statistically significant difference in the first-order barrier *lack of features in LMS* scores between the 20+ years of experience using digital tools (mean rank = 74.88) and 16–20 years of experience using digital tools (mean rank = 115.59, $p = .024$), but not between any other group combination.

Lastly, the results indicated that the mean ranks of the first-order barrier *lack of professional development about how to integrate LMS into instruction* scores were statistically significantly different among groups, $\chi^2(4) = 11.154$, $p = .025$. Subsequently,

195

I performed pairwise comparisons using Dunn's (1964) procedure with a Bonferroni

correction for multiple comparisons. Adjusted *p*-values are presented. This post hoc

analysis revealed statistically significant difference in the first-order barrier *lack of*

professional development about how to integrate LMS into instruction scores between the

20+ years of experience using digital tools (mean rank = 74.91) and ≤ 5 years of

experience using digital tools (mean rank = 109.42, *p* = .049), but not between any other

group combination. Table 20 presents the Kruskal-Wallis H tests results for 16 barriers

items in the survey by five different years of using digital tools for teaching groups of

faculty members.

Table 20

Kruskal-Wallis H Tests Results for Barriers to Technology Integration Based on Years of

Using Digital Tools for Teaching

Variables (survey items)	Group	*n*	Mean rank	χ2	df	*p*
First-order barriers						
1. Lack of time	≤ 5 years	42	94.58	4.395	4	.355
	6–10 years	43	108.06			
	11–15 years	44	93.97			
	16–20 years	33	96.97			
	20+ years	29	82.16			
2. Lack of technical support from my institution	≤ 5 years	42	99.39	7.850	4	.097
	6–10 years	43	86.50			
	11–15 years	44	106.60			
	16–20 years	33	104.44			
	20+ years	29	79.48			
3. Lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)	≤ 5 years	42	105.12	9.631	4	.047*
	6–10 years	43	89.84			
	11–15 years	44	98.78			
	16–20 years	33	102.62			
	20+ years	29	80.17			
4. Student lack of access to the LMS	≤ 5 years	42	104.13	7.840	4	.098
	6–10 years	43	95.88			
	11–15 years	44	99.68			
	16–20 years	33	100.58			
	20+ years	29	73.60			

Variables (survey items)	Group	n	Mean rank	$\chi2$	df	p
First-order barriers						
5. Hard to use across different types of devices (laptop, smartphone, tablet)	≤ 5 years	42	105.23	8.945	4	.062
	6–10 years	43	105.69			
	11–15 years	44	97.86			
	16–20 years	33	87.88			
	20+ years	29	74.69			
6. Student data privacy risk in LMS	≤ 5 years	42	95.17	.479	4	.976
	6–10 years	43	94.07			
	11–15 years	44	94.50			
	16–20 years	33	99.38			
	20+ years	29	98.50			
7. Navigation issues in LMS	≤ 5 years	42	110.93	10.645	4	.031*
	6–10 years	43	89.95			
	11–15 years	44	93.11			
	16–20 years	33	107.42			
	20+ years	29	74.72			
8. Lack of features in LMS (e.g., lack of collaborative learning tools, lack of customizable reporting)	≤ 5 years	42	108.80	14.121	4	.007*
	6–10 years	43	95.27			
	11–15 years	44	83.73			
	16–20 years	33	115.59			
	20+ years	29	74.88			
9. Lack of professional development about how to integrate LMS into instruction	≤ 5 years	42	109.42	11.154	4	.025*
	6–10 years	43	94.28			
	11–15 years	44	88.76			
	16–20 years	33	109.35			
	20+ years	29	74.91			
10. My students' motivation to use the LMS	≤ 5 years	42	107.48	6.255	4	.181
	6–10 years	43	94.08			
	11–15 years	44	86.91			
	16–20 years	33	106.29			
	20+ years	29	84.31			
Second-order barriers						
11. My comfort level with figuring out how to use the LMS	≤ 5 years	42	109.75	7.809	4	.099
	6–10 years	43	88.31			
	11–15 years	44	93.68			
	16–20 years	33	104.21			
	20+ years	29	81.66			
12. My confidence in using the LMS for teaching	≤5 years	42	108.21	5.789	4	.215
	6–10 years	43	93.77			
	11–15 years	44	91.14			
	16–20 years	33	101.26			
	20+ years	29	83.02			
13. My motivation to use the LMS	≤ 5 years	42	108.06	6.695	4	.153
	6–10 years	43	99.92			
	11–15 years	44	87.16			
	16–20 years	33	97.65			
	20+ years	29	84.26			
14. My pedagogical beliefs (teaching philosophy)	≤ 5 years	42	103.40	3.622	4	.460
	6–10 years	43	94.08			
	11–15 years	44	99.10			
	16–20 years	33	96.89			

Variables (survey items)	Group	n	Mean rank	$\chi2$	df	p
First-order barriers						
	20+ years	29	82.40			
15. My beliefs about how learning happens	≤ 5 years	42	101.76	1.548	4	.818
	6–10 years	43	96.79			
	11–15 years	44	96.50			
	16–20 years	33	94.33			
	20+ years	29	87.62			
16. My attitudes towards using LMS	≤ 5 years	42	100.88	3.187	4	.527
	6–10 years	43	101.77			
	11–15 years	44	95.78			
	16–20 years	33	92.98			
	20+ years	29	84.14			

*p = <.05

6.3.6 Years of Using an LMS for Teaching and Barriers to Technology Integration

I conducted 16 Kruskal-Wallis H tests to determine if there were differences in the identification of significant barriers among four groups of faculty members' years of using an LMS for teaching. The ordinal dependent variables included 10 first-order barriers survey items and six second-order barriers survey items measured on a 4-point Likert scale from *not a barrier* to *a significant barrier*, and the independent variable was years of using an LMS, which had four groups: ≤ 3 years (n = 49), 4–6 years (n = 54), 7–9 years (n = 39), and 10+ years (n = 49). The level of significance was set at .05.

The results indicated that the mean ranks of the second-order barrier *my confidence in using the LMS for teaching* scores were statistically significantly different among groups, $\chi^2(3)$ = 8.140, p = .043. Subsequently, I performed pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted p-values are presented. This post hoc analysis revealed statistically significant difference in the second-order barrier *my confidence in using the LMS for teaching* scores between the 7–9 years of experience using LMS (mean rank = 81.18) and the ≤ 3 years of

experience using LMS (mean rank = 110.20, p = .029), but not between any other group combination. Table 21 presents the Kruskal-Wallis H tests results for 16 barriers items in the survey by four different years of using an LMS for teaching groups of faculty members.

Table 21

Kruskal-Wallis H Tests Results for Barriers to Technology Integration Based on Years of Using an LMS for Teaching

Variables (survey items)	Group	n	M	SD	Mdn	Mean rank	$\chi2$	df	p
First-order barriers									
1. Lack of time	≤ 3 years	49	1.1	0.9	1.0	104.94	2.810	3	.422
	4–6 years	54	1.0	1.0	1.0	97.87			
	7–9 years	39	1.0	1.0	1.0	92.06			
	10+ years	49	0.9	0.9	1.0	88.13			
2. Lack of technical support from my institution	≤ 3 years	49	0.9	1.0	1.0	109.98	5.976	3	.113
	4–6 years	54	0.6	0.8	0.0	91.39			
	7–9 years	39	0.6	0.7	1.0	96.41			
	10+ years	49	0.5	0.6	0.0	86.78			
3. Lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)	≤ 3 years	49	0.4	0.7	0.0	101.03	1.135	3	.769
	4–6 years	54	0.2	0.5	0.0	94.36			
	7–9 years	39	0.2	0.6	0.0	94.05			
	10+ years	49	0.2	0.6	0.0	94.33			
4. Student lack of access to the LMS	≤ 3 years	49	0.7	0.7	1.0	106.10	3.611	3	.307
	4–6 years	54	0.5	0.6	0.0	96.99			
	7–9 years	39	0.5	0.6	0.0	90.96			
	10+ years	49	0.5	0.7	0.0	88.82			
5. Hard to use across different types of devices (laptop, smartphone, tablet)	≤ 3 years	49	0.8	0.8	1.0	100.65	1.912	3	.591
	4–6 years	54	0.7	0.8	1.0	98.26			
	7–9 years	39	0.7	0.8	1.0	97.64			
	10+ years	49	0.6	0.8	0.0	87.55			
6. Student data privacy risk in LMS	≤ 3 years	49	0.5	0.8	0.0	102.20	3.905	3	.272
	4–6 years	54	0.3	0.5	0.0	100.90			
	7–9 years	39	0.2	0.4	0.0	90.37			
	10+ years	49	0.2	0.5	0.0	88.88			
7. Navigation issues in LMS	≤ 3 years	49	1.0	0.9	1.0	104.71	3.642	3	.303
	4–6 years	54	0.9	0.9	1.0	98.54			
	7–9 years	39	0.9	1.0	1.0	95.13			
	10+ years	49	0.7	0.9	0.0	85.18			
8. Lack of features in LMS (e.g., lack of collaborative learning tools, lack of customizable reporting)	≤ 3 years	49	1.0	1.0	1.0	93.04	2.829	3	.419
	4–6 years	54	1.2	0.9	1.0	104.90			
	7–9 years	39	1.1	1.0	1.0	97.33			
	10+ years	49	1.0	0.9	1.0	88.09			

Variables (survey items)	Group	n	M	SD	Mdn	Mean rank	$\chi2$	df	p
First-order barriers									
9. Lack of professional development about how to integrate LMS into instruction	≤ 3 years	49	1.0	1.1	1.0	106.71	7.072	3	.070
	4–6 years	54	0.7	0.8	1.0	97.44			
	7–9 years	39	0.8	0.9	1.0	100.09			
	10+ years	49	0.5	0.8	0.0	80.45			
10. My students' motivation to use the LMS	≤ 3 years	49	1.0	1.1	1.0	99.60	1.087	3	.780
	4–6 years	54	0.9	0.8	1.0	99.09			
	7–9 years	39	0.7	0.9	0.0	89.64			
	10+ years	49	0.8	0.9	1.0	94.05			
Second-order barriers									
11. My comfort level with figuring out how to use the LMS	≤ 3 years	49	0.8	0.9	1.0	108.47	5.012	3	.171
	4–6 years	54	0.5	0.7	0.0	88.22			
	7–9 years	39	0.5	0.8	0.0	90.37			
	10+ years	49	0.6	0.7	0.0	96.58			
12. My confidence in using the LMS for teaching	≤ 3 years	49	0.8	0.9	1.0	110.20	8.140	3	.043*
	4–6 years	54	0.4	0.6	0.0	93.72			
	7–9 years	39	0.3	0.6	0.0	81.18			
	10+ years	49	0.5	0.6	0.0	96.10			
13. My motivation to use the LMS	≤ 3 years	49	0.6	1.0	0.0	101.10	2.946	3	.400
	4–6 years	54	0.5	0.8	0.0	100.46			
	7–9 years	39	0.3	0.5	0.0	86.28			
	10+ years	49	0.4	0.7	0.0	93.71			
14. My pedagogical beliefs (teaching philosophy)	≤ 3 years	49	0.7	1.1	0.0	99.54	2.190	3	.534
	4–6 years	54	0.7	0.9	0.0	101.68			
	7–9 years	39	0.4	0.7	0.0	89.87			
	10+ years	49	0.5	0.7	0.0	91.08			
15. My beliefs about how learning happens	≤ 3 years	49	0.7	1.0	0.0	99.53	3.846	3	.279
	4–6 years	54	0.7	0.9	0.0	104.32			
	7–9 years	39	0.4	0.6	0.0	87.79			
	10+ years	49	0.5	0.8	0.0	89.83			
16. My attitudes towards using LMS	≤ 3 years	49	0.7	1.0	0.0	102.08	3.989	3	.263
	4–6 years	54	0.6	0.9	0.0	102.26			
	7–9 years	39	0.3	0.6	0.0	89.00			
	10+ years	49	0.4	0.7	0.0	88.59			

*p = <.05

6.4 Summary

In summary, the results indicated that LMS platforms and gender did not influence faculty's identification of barriers to technology integration. There was no significant difference among faculty who used Moodle, Blackboard Learn, and Canvas when first-order and second-order barriers were examined. There was no significant

difference between female faculty members and male faculty members when first-order and second-order barriers were examined.

When age was examined in relation to the first-order and second-order barriers, there was a significant finding. The analysis of the data revealed that faculty who were 40 years old and younger perceived that the first-order barrier *hard to use across different types of devices (laptop, smartphone, tablet)* was more of a barrier than faculty who were 41–49 years old.

When teaching experience was examined in relation to the first-order and second-order barriers, there was a significant finding. The analysis of data revealed that faculty with 10 years or less of teaching experience perceived that the first-order barrier *hard to use across different types of devices (laptop, smartphone, tablet)* as more of a barrier than faculty with 11–20 years of teaching experience.

When faculty years of using digital tools for teaching was examined in relation to the first-order and second-order barriers, there were several significant findings. First, the analysis of data revealed that faculty's years of using digital tools for teaching influenced the first-order barrier *lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)*, although the statistical testing was not able to identify any difference between the groups. Second, the data analysis revealed that faculty with 5 years or less experience using digital tools for teaching perceived that the first-order barrier *navigation issues in LMS* was more of a barrier than faculty with over 20 years of experience using digital tools for teaching. Third, the data analysis revealed that faculty with 11–20 years of experience using digital tools for teaching perceived that the first-order barrier *lack of features in LMS* was more of a barrier than faculty with over 20

201

years of experience using digital tools for teaching. Lastly, the analysis of data revealed faculty with 5 years or less experience using digital tools for teaching perceived that the first-order barrier *lack of professional development about how to integrate LMS into instruction* was more of a barrier than faculty who had over 20 years of experience using digital tools for teaching.

When faculty years of using an LMS for teaching was examined in relation to the first-order and second-order barriers, there was one significant finding. The analysis of the data revealed that faculty with 3 years or less experience using LMS perceived that the second-order barrier *confidence in using the LMS for teaching* was more of a barrier than faculty with 7–9 years of experience using LMS.

6.5 Conclusion

This chapter presents findings to answer questions *R3* and *R3a*:

Based on the descriptive results of the survey responses, the participants did not report significant first-order and second-order barriers that challenged the use of LMS. However, there were still three first-order barriers and three second-order barriers that many faculty struggled with: *lack of features*, *lack of time*, *navigation issues*, *comfort level with figuring out how to use the LMS*, *beliefs of how learning happens*, and *pedagogical beliefs (teaching philosophy)*. The findings in this data set indicated that there seemed to be a significant overlap between first-order and second-order barriers. First, the second-order barrier: *comfort level with figuring out how to use an LMS* tended to be negatively influenced by first-order barriers, such as lack of time, poor technical support, and poor interface design. Second, faculty's *beliefs about how learning happens*

(learning theories) were affected by their comments about the first-order barrier of *lack of features*, as faculty were more likely to use features that aligned to the learning theories they applied in their instruction. Likewise, faculty's teaching philosophy influenced what features they chose to use and how they used the features; this also impacted their comments about the first-order barrier of *lack of features*. Overall, the findings indicated that first-order and second-order barriers can both impact faculty's LMS use, and that, first-order and second-order barriers are often intertwined.

Overall, the participants in this data set did not report that the listed first-order and second-order barriers posed a significant challenge to their use of LMS, on average. However, when demographic factors were examined in relation to the first-order and second-order barriers, there were several significant findings. Faculty members who were younger (≤ 40 years old) and faculty with less teaching experience (≤ 10 years) seemed to have experienced more of the first-order barrier *hard to use across different types of devices.* Faculty's experience using digital tools for teaching seemed to be a factor that influenced the first-order barrier *lack of access to the LMS*, although the analysis was not able to indicate which group was affected more. Faculty with less experience using digital tools for teaching (≤ 5 years) seemed to have experienced more of a first-order barrier of *navigation issues* and *lack of professional development about how to use integrate LMS into instruction*. Faculty with more experience using digital tools for teaching (16–20 years) were likely to experience more of a barrier of *lack of features.* Faculty with less experience using LMS for teaching (≤ 3 years) were likely to experience the second-order barrier *confidence in using the LMS for teaching*. The results indicated many first-order barriers were influenced by years of using digital tools, while

the intrinsic, second-order barrier *confidence in using the LMS for teaching* was

influenced by years of faculty's experience using an LMS for teaching.

CHAPTER 7

DISCUSSION AND CONCLUSION

7.1 Introduction

Learning Management Systems (LMSs) have become widely used in higher education, changing how faculty members interact with the teaching and learning processes. Understanding the factors that influence faculty use of LMS, their usage patterns, and the challenges they face has become essential as this technology plays a vital role in higher education. In this chapter, I provide a summary of the key findings, interpretations of the data, and connections of the findings to the prior literature for each of the research questions. The first research question (RQ1) explored why faculty members use LMS in U.S. higher education. I will use the Technology Acceptance Model (TAM) to discuss faculty LMS adoption. RQ1a, a sub question of RQ1, went into greater detail about the relationship between demographic characteristics and why faculty members use an LMS.

The second research question (RQ2) concerned how faculty members use an LMS in U.S. higher education. I referenced the PICRAT model, which offers a theoretical framework for examining the relationship between users (faculty and students) and technology, in this discussion. RQ2a, a related sub question, examined the connection between demographic variables and how instructors use LMS.

The third research question (RQ3) then investigated the barriers that affect faculty utilization of LMS in U.S. higher education. This section discusses faculty members' barriers and how they affect LMS adoption and integration. RQ3a then explored the

interactions between these barriers and demographic factors, offering insightful information about the varied experiences of faculty members based on their demographics.

This discussion adds to the knowledge on technology integration in U.S. higher education by addressing these research issues and examining the connections between demographic characteristics, LMS adoption, LMS usage, and barriers. The results and interpretations will give educators, scholars, faculty professional development initiatives and other stakeholders a deeper comprehension of the elements that affect faculty acceptance and use of LMS, allowing them to create efficient plans and support systems.

7.2 RQ1: Why Do Faculty Use an LMS in U.S. Higher Education?

Three significant themes: *host course materials*, *communication with students* and *university policy/required* can be drawn from the important findings on the factors that influence faculty members' decision to adopt an LMS in U.S. higher education. The most reported reason why LMS was used was to *host course materials*, a response which was given by 55% ($n = 106$) of respondents and which accounted for 23.5% of the coded themes. Faculty uploaded and shared syllabi, readings, lecture videos, presentations, and other course materials, as well as extra resources, via the LMS. Participants also specified that the LMS enabled them to conveniently display Internet links leading to relevant outside resources, including Padlet and Google Docs. These resources were easily accessible to students because they were kept and distributed centrally through the LMS. This discovery emphasized the value of the LMS as a repository for materials relevant to courses, improving content management and delivery.

The second most common use of LMS was for *communication with students*, which was reported by 42% (*n* = 80) of respondents and accounted for 17.7% of the coded themes. To communicate with their students, faculty used LMS features like the announcements and email features. The mass communication capability of the announcements function enabled professors to share information with the entire class. Additionally, the LMS allows faculty members to email students directly in the system, facilitating fast and convenient mass communication with the class. According to the data, the LMS provided efficient communication between professors and students outside of class time.

The third commonly reported reason for LMS use by faculty members was because it was *required by the university's policy*. As high as 32% (*n* = 62) of participants identified this as the reason why they used an LMS, typically in the form of the minimum required use of the platform. The LMS could be used to post contact details, syllabi, assignments, grades, and other course-related data as part of these requirements. A notable trend in this theme was that institutional requirements for using LMS increased significantly during the COVID-19 pandemic, with one faculty member pointing out that after the outbreak, the expected minimum use of Blackboard Learn increased from merely posting instructors' contact information to extensive hosting of most or all course material and announcements on the system. Faculty members used the LMS as a platform to follow the rules set forth by the university. This conclusion stressed the value of the LMS as a tool for institutional compliance and emphasized the part institutional mandates played in influencing faculty adoption of LMS.

Interestingly, the investigation on why faculty used an LMS did not identify the facilitation of learning as a major reason. Overall, the results revealed multiple reasons for participants' use of three LMS platforms, but using an LMS to *facilitate learning activities* was not a common reason.

These results indicated the most crucial drivers of the technology's adoption. The use of the platforms for material hosting indicated that faculty saw the LMS as a convenient hub for organizing and disseminating essential course content to students, a variable that aligned with the Perceived Usefulness (PU) construct of the Technology Acceptance Model (TAM) (Davis, 1989). The TAM states that PU and Perceived Ease of Use (PEOU) are the two main factors that affect a user's intention to utilize technology (Davis, 1989). While PEOU refers to the perception that utilizing a certain system will be effortless, PU refers to the notion that using the system will improve work performance. This framework emphasizes that faculty must understand how an LMS can benefit their job before considering its adoption.

The TAM has grown over time to encompass external factors that affect perceptions of usefulness. Venkatesh and Davis (2000) proposed the TAM2 using the TAM as a foundation. This model considers seven other factors that affect PU. These factors can be divided into cognitive instrumental processes (job relevance, output quality, and outcome demonstrability) and social influence processes (subjective norm, image, experience, and voluntariness). These variables enable a more thorough comprehension of the elements affecting faculty adoption of LMS.

In this study, the three most common reasons for using an LMS confirmed that faculty's intention to use an LMS was driven by the two external variables that

208

influenced PU in TAM2: job relevance and subjective norm. The two common reasons of *host course materials* and *communication with students* can be categorized as the cognitive instrumental process variable of job relevance. Faculty's perceptions of the degree to which an LMS might be important in their jobs rested on whether it allowed them to accomplish academic activities, such as delivering course resources and keeping in touch with students. Because the function of an LMS met a threshold value of perceived job relevance, faculty perceived the usefulness of using an LMS; therefore, they were more inclined to adopt the LMS. The findings also confirmed previous research which stated that the course management function in an LMS was useful, and it was the most common usage for faculty (Gierdowski & Galanek, 2020; Goh et al., 2014).

The third common reason why faculty used an LMS, *university policy*, can be categorized as the social influence variable of subjective norm. Faculty's understanding of the value of using an LMS was driven by their perception that its use was required, as, often, it was an institution-wide policy. Faculty chose to use an LMS, even if they were not inclined towards doing so, if they believed that others in an institution thought they should. While it might not be the case that all the universities required faculty to use an LMS, many faculty in this study reported they used the LMS because it was mandatory. These findings support Venkatesh and Davis' (2000) research, which stated that "subjective norm had a significant effect on intention in mandatory settings but not in voluntary setting" (p. 188). As such, the subjective norm seems to have had an influence on faculty's LMS adoption, especially when using that LMS was mandatory.

Based on the qualitative data analysis, the findings in this study showed that the three most common reasons why faculty used an LMS matched the external variables, job

209

relevance and subjective norm, in TAM2 (Venkatesh & Davis, 2000). These two external variables influenced the determinant, PU, and influenced faculty's LMS adoption. Through the themes found in this data set, the findings did not indicate that PEOU was one of the main reasons why faculty used an LMS. This finding suggests that the determinant's PU seems to have had a stronger effect on faculty's LMS adoption than the determinant's PEOU. This supports the prior research conclusion that PU is the strongest predictor of users' intention to adopt a technology (Venkatesh & Davis, 2000).

The findings on the reasons for using LMS also aligned with the results reported in previous literature. Other studies have highlighted the utility of LMS platforms in hosting course material and communicating with learners as important motivators for their use. For instance, Goh et al. (2014) found that instructors valued the usefulness of Moodle as a centralized platform for hosting course content and passing announcements to learners. Consequently, the platform's most visible role in instruction was for uploading and sharing teaching material. Similar findings were reported by Gierdowski and Galanek (2020), who noted that the most widely utilized LMS functions were directed at course management. In addition, the current study's findings extrapolated the extant literature by including university policy as a key motivation for adopting LMS, highlighting the potential role of managerial support and guidance in increasing the use of such instructional technology in U.S. higher education. Overall, the findings reflect previous patterns identified by existing investigations on LMS adoption.

It is clear from these results that faculty members used an LMS largely for administrative and logistical needs. The LMS was a central hub for hosting and disseminating course materials, promoting mass communication, and adhering to

210

institutional regulations. Although *facilitating learning activities* was not one of the top three reasons the participants gave for using an LMS, it is crucial to emphasize that the results do not undervalue the potential of LMSs in this regard. Instead, they focus on academic goals and usage patterns in U.S. higher education. The findings add to the body of literature by offering evidence of how common these usage patterns are among faculty in U.S. higher education. They expand the body of knowledge by emphasizing the impact of institutional policies on LMS acceptance and usage.

The findings of this study have important educational ramifications. They emphasize the necessity for intuitive and effective LMS platforms that prioritize hosting and distributing course materials. LMS designers should keep enhancing the functions that facilitate simple content uploading, organization, and sharing. The results also highlight the significance of communication features in an LMS. LMS tools are perceived as convenient and efficient means of connecting with students, sharing important course updates, and fostering mass communication channels. By adopting the platforms, faculty can ensure that students receive timely information, especially outside of class time. LMS designers should also investigate how to improve ease-to-use features and interface, as the findings did not show that faculty's top reasons for adopting an LMS was because of its ease-of-use. The findings can bring attention to faculty professional development initiatives about designing training aimed to familiarize faculty with how to use the LMS more efficiently and introducing less used features.

7.3 RQ1a: What is the Relationship Between Demographic Factors and Why Faculty Use an LMS in U.S. Higher Education?

This research question sought to identify links between the reasons for LMS use and specific demographic factors, including LMS platform, faculty member age, gender, teaching experience, experience with using digital teaching tools, and experience using LMS. The reasons identified for use of LMS included *host course materials*, *communication with students*, *management of assignments*, as well as *support for and requirement of LMS system use* by the university. The most notable finding was that faculty with a shorter teaching experience, fewer years of using digital tools, and fewer years of using an LMS were more likely to report using the LMS because of university policy mandates. No noteworthy trend emerged linking the other demographic variables, age, and gender, to adherence to university policy as a reason for LMS utilization.

Another notable finding was a positive relationship between the use of LMS for *assignment management* and the faculty's age group, with participants aged 50 years or more reporting that this was their third leading reason for using the LMS platforms. In addition to faculty members' age, the identification of assignment management as a reason for LMS use was also related to the teaching experience of the participants. Specifically, the group that was most likely to mention assignment management as the third most common reason for using LMS consisted of faculty with 11–20 years of teaching experience and those with 11–20 years of using digital tools for teaching. This could be because faculty who are older, faculty with 11–20 years of teaching experience and 11–20 years of using digital tools have had enough experience and skills to use a wider array of LMS management features, whereas faculty with less teaching experience and less experience of using digital tools used an LMS in a limited capacity. Altogether,

212

the results indicated a role for teaching experience and years of using digital teaching

tools and specific reasons for utilizing LMS platforms.

The association between demographic variables and why LMS was used could be

interpreted from the perspective of the TAM2 (Venkatesh & Davis, 2000). Faculty

members who were less experienced with teaching, less familiar with digital tools, and

less familiar with LMS could perceive the LMS platform as a requirement imposed by

the university, leading them to comply with the policy and adopt the LMS for their

teaching activities, whether they perceived it to be useful or not. This suggests that

external pressures, a subjective norm, such as institutional mandates, played a significant

role in shaping faculty members' acceptance and use of LMS platforms. Conversely,

older faculty members might value the LMS platform for its ability to facilitate

assignment management, which aligned with the TAM2 (Venkatesh & Davis, 2000)

construct of job relevance. Older faculty members, who may have more experience with

teaching and using digital tools, may recognize the benefits and efficiency of using an

LMS for managing assignments, leading to their increased adoption of this feature.

Similarly, faculty members with a moderate level of teaching experience (11–20 years)

and considerable digital tool usage had developed a deeper understanding of the benefits

and practicality of using an LMS for managing assignments. They may have perceived

the LMS as a useful tool for streamlining the assignment process, organizing student

submissions, and providing timely feedback. These findings support Venkatesh and

Davis' (2000) research, which states that "the direct effect of subjective norm on

intentions for mandatory usage contexts will be strong prior to implementation and

during early usage but will weaken over time as increasing direct experience with a system provides a growing basis for intentions toward ongoing use" (p. 190).

The relatively limited association between demographic traits, particularly age and gender, and LMS use was identified in the literature. For instance, a study by Alosaimi et al. (2021) found no significant association between faculty members' age or gender and their intention to use LMS platforms in Saudi Arabian schools. Similarly, Amankwah et al. (2022) found no link between sociodemographic such as gender and age in the adoption of Moodle in Ghanaian universities.

However, the interesting point is that *facilitating learning activities* was not reported as a top reason for LMS adoption among faculty members, as ironically, LMS stands for learning management system. Yet, it was used as a course management system due to its missing features that did not support faculty's teaching philosophy, poor interfaces design, and time-consuming to learn a lot of features. This suggests that there may be untapped potential for leveraging LMS platforms to create interactive and engaging learning experiences. Faculty professional development initiatives should design training to support faculty members (especially younger faculty, faculty with less teaching experience, faculty with less experience of using digital tools, and faculty with less experience of using LMS for teaching) to explore innovative pedagogical approaches and to design interactive and creative learning activities, such as using discussion forums to facilitate online discussion and creating collaborative projects via the Wiki feature to harness the full potential of LMS platforms for facilitating active learning and student engagement. LMS designers should keep improving features and interface that can be

easier and effective to support facilitating learning activities that succeed features in other competitive technological tools.

7.4 RQ2: How do Faculty Use an LMS in U.S. Higher Education?

The findings revealed that faculty members used LMS as a platform to *host course materials* and to *communicate with students*. The most reported use for LMS among participants was hosting course materials, including syllabi, course links, and asynchronous lecture content. As a hosting site for course materials, an LMS provided a suitable repository for a wide range of media types, including videos, lecture recordings, PowerPoint presentations, readings, and links. The resources could be uploaded and asynchronously accessed by students using the LMS, making it a useful central storage for a variety of materials. Another reported approach of using an LMS was communication with students, either *en masse* through the announcement feature or through emails. Collectively, these uses comprise a repertoire for communication and file-sharing between professors and students. The third most reported use of the LMS platforms was management of assignments. Faculty members reported using an LMS to post, collect, and return assignments to students on LMS sites. Other identified uses included grading and administration of quizzes and tests.

One of the key findings in this study revealed that *facilitating learning activities* was one of the least approaches of how faculty used an LMS. This finding reflected previous studies that suggested that the discussion board and forum features were not commonly used tools for facilitating learning by faculty (Al-Sharhan et al., 2020; Hijazi et al., 2020; Northern Illinois University, 2021; Rhode et al., 2017; Whitmer et al., 2016).

215

The results indicate the most notable ways in which faculty members employed LMS platforms for teaching. Faculty members extensively relied on LMS platforms as a centralized hub for hosting course materials, indicating that faculty used an LMS more like a content management system, as an LMS offered a convenient and versatile platform for storing and distributing a wide range of course resources. In addition, the LMS served as a medium for effective mass communication between faculty members and students. Moreover, the platforms offered convenience and efficiency in handling assignment-related tasks. As such, faculty members found it beneficial to disseminate and collect assignments through the sites, streamlining the process and providing a structured approach to assignment management. The features that support learning in an LMS fall short.

From the perspective of the PICRAT model, the reported LMS use cases were located at the bottom-left corner of the PICRAT matrix, indicating a Passive-Replacement (PR) focused use of the LMS. Although some Interactive-Replacement (IR) activities were reported, such as students directly completing assignments or taking quizzes/exams/tests in the LMS, no higher-level uses of the LMS (such as creative or transformative uses) were found in the data set. This pattern suggests that faculty members predominantly utilized LMS platforms for basic functions rather than for more advanced or creative purposes.

These findings have two consequences for instructors. They emphasize the importance of faculty development and training programs focusing on the technical aspects of using an LMS and instructional practices that optimize the platform's potential. Faculty members should be encouraged to investigate and use LMS features

beyond administrative responsibilities, allowing students to engage in interactive and collaborative learning experiences. Faculty could use the PICRAT as a self-reflective framework to examine and improve practices when integrating technology. Second, universities should evaluate the design and implementation of LMS platforms corresponding to faculty members' educational goals and priorities. LMS designers should improve features that complement instructional tactics and allow meaningful interactions between professors and students.

These findings support previous research findings which suggested that faculty used features and tools in an LMS to administer course materials, assignments, and to communicate with students (Rhode et al., 2017; Washington, 2019). The findings indicated that faculty members mostly used the LMS for administrative purposes rather than fully utilizing its potential to foster interactive and engaging learning experiences. The findings support previous research findings which suggests that instructors' practices and LMS use are located at the bottom-left corner (Passive-Replacement) of the PICRAT matrix (Asim et al., 2022; Hill, 2021; Wang, 2023) The findings add to the current literature by giving empirical evidence of popular usage patterns among faculty members in higher education in the United States. The findings also highlight the importance of shifting the emphasis from mostly administrative use to include instructional practices that promote active learning and student participation. Recognizing present usage patterns and noting the potential of LMS platforms allows educators and institutions to strive toward fully utilizing the technology to improve teaching and learning experiences.

7.5 RQ2a: What is the Relationship Between Demographic Factors and How Faculty Use an LMS in U.S. Higher Education?

The results showed intriguing connections between a faculty member's use of an LMS and demographic variables in U.S. higher education. Insights into LMS usage patterns can be gained by analyzing the responses based on several demographic categories, including LMS platforms, gender, age, teaching experience, experience using digital tools, and experience using an LMS. The major findings revealed that faculty across the six groups reported the following five common approaches of how they used an LMS: 1) *host course materials*, 2) *communication with students*, 3) *manage assignments*, 4) *host quizzes/exams/tests*, and 5) *grading/Gradebook*. The most frequent approach faculty members cited across all demographics was *host course materials*. This showed that faculty members consistently used the LMS as a central repository for exchanging course information, independent of the demographic variables. While most relevant studies had focused on features in an LMS that faculty frequently used, no empirical study had focused on how demographic factors influenced faculty's approaches to using an LMS in U.S. higher education. However, the finding in this study was consistent with previous research suggesting that course management functions were the most common approach as to how faculty used an LMS (Al-Sharhan et al., 2020; Hijazi et al., 2020; Northern Illinois University, 2021; Rhode et al., 2017; Whitmer et al., 2016).

Examining the various LMS platforms, faculty members using Moodle and Canvas reported that *managing assignments* was one of their most frequent approaches. On the other hand, faculty members using Blackboard Learn mentioned *hosting quizzes/exams/tests* as the third most popular method. These results implied that the

selected LMS platform might impact how faculty members used the system, as certain platforms offered features more closely matched to specific jobs.

Both male and female faculty respondents emphasized *hosting course materials* and *communicating with students* as their top two frequent techniques. However, the research revealed that the extent to which the platforms served as grading tools depended on the faculty members' gender, age, teaching experience, experience with using digital tools, and experience with LMS. Female faculty were more likely to utilize the LMS for *managing assignments*, while male faculty appeared to be more focused on utilizing it for *grading/Gradebook*. While *hosting course materials* remained the most popular strategy across age groups, younger faculty members (those 40 years of age or younger) placed a greater priority than their more senior counterparts on using the LMS for *grading/Gradebook*. The findings also included a higher tendency for use of LMS for grading among faculty members with less teaching experience, particularly those who had been teaching for 10 or fewer years. Similarly, faculty members with 6 to 10 years using digital tools, along with those with 3 or fewer years using an LMS, were more likely to report using the platforms for *grading/Gradebook*. Altogether, the utilization of LMS for grading was more common among male faculty members, faculty members with less extensive experiences in teaching, using digital instructional tools, and using an LMS. The possible explanation might be faculty with less experience in teaching, using digital tools, and an LMS are more likely to follow university policy for required usages, such as posting grades.

The variation in how LMS was utilized by faculty members implies that the technology's use was dependent on various demographic factors. The gender difference

in LMS use for grading suggested that there may be variations in preferences, comfort, or familiarity with using digital tools for assessment and grading among different genders. Moreover, the age-related difference in LMS use for grading may reflect differences in digital fluency, differences in younger faculty's need to follow university policy regarding posting grades. Alternatively, it may be indicative of a nuanced appreciation of the limitations of the Grading features of the platform by the older and more experienced faculty members. Furthermore, the results highlight variations in the use cases across different LMS platforms, which may stem from the specific features, user interfaces, or institutional norms associated with each LMS platform that may influence professors' preferences and practices. Overall, the acknowledgement of the association between age, experience, and platform type and how LMS is applied in higher education can inform training, support, and customization efforts to optimize the adoption and use of LMS platforms among educators.

According to the previous literature, these results are consistent with earlier research on the predominant administrative usage of LMS in higher education (Al-Sharhan et al., 2020; Hijazi et al., 2020; Northern Illinois University, 2021; Rhode et al., 2017; Whitmer et al., 2016). This research shows the connections between demographic variables and LMS utilization trends. The lack of empirical results supporting variations in how LMS is used by different faculty demographic groups suggests a need for additional research in this area. Moreover, the findings underscore the potential utility of a nuanced understanding of the role that LMS plays in different groups, the application of which could increase the adoption and outcomes of such platforms in targeted pedagogical settings.

The PICRAT model provided a lens through which to investigate how LMS was used by faculty in this research. According to RQ2's primary findings, faculty used the LMS at the PICRAT model's Passive-Replacement (PR) levels. Faculty members cited *hosting course materials*, *communicating with students*, and *managing assignments* as their most effective strategies. These actions are consistent with the Passive level, where the LMS serves largely as a hub for administrative and content delivery responsibilities. The LMS replaced the syllabi, readings, and lecture recordings that faculty members once used to distribute course materials. Faculty also used the LMS to communicate with students via email or announcement features. The management of assignments, including submitting and returning student work, was also done through the LMS. These actions show how digital alternatives are taking the place of conventional methods.

Like RQ1a, RQ2a investigated the connection between demographic variables and faculty members' LMS usage. The results of RQ2a matched up with the PICRAT model's Passive-Replacement (PR) levels. Faculty members frequently utilized the LMS to host course materials, communicate with students, and manage assignments across various demographic groups. No matter their teaching experience, gender, age, or use of digital tools, faculty members continued to use the LMS mostly for PR activities. This implied a regular pattern of LMS use in the context of higher education.

The findings showed that faculty reported some Interactive-Replacement (IR) and Passive-Amplification (PA) activities. Faculty used the LMS to replace the traditional form of paper-form quizzes or exams, with students interacting with the LMS. The activities such as posting videos or recorded lectures to an LMS can be seen as PA, as students could watch videos multiple times in any location; therefore, faculty's use of an

221

LMS amplified traditional practice. Students could also access all the course content in one place anytime and anywhere; since this could not be done with a paper form, faculty's use of an LMS amplified traditional practice (PA). Unfortunately, the findings in this study did not suggest higher-level uses of an LMS (located at the top-right corner of the PICRAT matrix, e.g., Creative, Transformation). The PICRAT model (Kimmons, 2016; Kimmons, et al., 2020) is a relatively new technology integration framework, and there is limited research investigating how faculty members used LMS for their instruction in U.S. higher education that is guided by the PICRAT model. Therefore, the findings in this study were not able to be compared to previous research.

When the results of RQ2 and RQ2a are connected to the PICRAT model, PR activities made up the majority of how faculty used LMS in U.S. higher education. This suggests that rather than fully using the LMS's potential for transformation and creativity, faculty members mostly used it to replace conventional educational approaches (Asim et al., 2022). The LMS replicated content distribution and administrative functions previously carried out physically by acting as a digital repository for course materials.

The research highlights the need for educators and institutions to go past the LMS's PR usage. It stresses the significance of encouraging greater technology integration to promote interactive and creative learning experiences, to enhance teaching and learning through creative LMS applications, and ultimately to support pedagogical reform. By advancing to these higher levels, faculty members can use LMS features that encourage critical thinking, collaboration, and student engagement.

The findings have relevance for staff at institutions and in professional development initiatives who want to comprehend and encourage faculty members' use of LMS. Professional development opportunities for educators that emphasize using LMS capabilities beyond administrative work and instructional practices and that encourage active learning and student involvement can be helpful. Institutions should offer extensive professional development opportunities for faculty members to close the gap between present LMS usage and higher levels of the PICRAT model. Introducing a technology integration framework like the PICRAT model to faculty members as a course planning tool and a reflective instrument helps faculty members have a start point to understand and contrast their LMS usage with more traditional approaches and understand how students use an LMS to advance their learning. The initiative may center on pedagogical techniques that make the most of the LMS's interactive capabilities, promoting group learning activities and aiding in creative evaluation and feedback methods. Institutional resources and support should also be granted to enable faculty to investigate and put transformational practices into practice within the LMS.

7.6 RQ3: What Barriers Influence Faculty Use of LMS in U.S. Higher Education?

The third primary research question investigated what first-order and second-order barriers influenced faculty members' LMS use. The findings were presented in both quantitative and qualitative analysis. Based on the descriptive statistical results of the survey responses, faculty did not report significant first-order and second-order barriers that challenged the use of LMS. Faculty self-reported that they experienced both first-order barriers and second-order barriers as *not a barrier* to a *minimal barrier*, on average.

However, faculty reported the three most highly rated first-order barriers that presented more of a challenge to be *lack of features in LMS*, *lack of time*, and *navigation issues in LMS*. Specifically, faculty members reported that multiple features were unavailable in their respective LMS platforms, such as real-time interaction and collaboration, programming and math practice features, an easy-to-use gradebook, easy-to-use templates, and a user-friendly interface design. The results show that LMS features need to be continuously improved and enhanced to meet the needs of instructors across various academic disciplines. Moreover, participants reported limitations in the document formats and sizes of files that could be posted on some LMS sites.

Another challenge identified by participants was the need to devote a significant amount of time to understanding the advanced features of an LMS. Faculty members frequently gave priority to the preparation of teaching materials and research, leaving them with little spare time to learn and use advanced LMS capabilities. The time needed to overcome technical challenges was prolonged by slow response from support staff, making the experience too time-consuming and unpleasant for faculty members. These findings confirm previous research that suggests that *lack of time* is a first-order barrier that impacts faculty's LMS use (Al Meajel & Sharadgah, 2017; AlQuadh, 2014; Saleem et al., 2016). The findings in this study also suggest that lack of time was exacerbated by other barriers, such as delayed tech support, poor LMS interface design, and faculty's internal beliefs about the importance of dedicating time to other work commitments or learning to use features in an LMS.

While delayed tech support and poor interface design are extrinsic barriers, faculty's concern about how to dedicate their time can be considered intrinsic barriers, as

224

this is related to their attitude toward their own time management and toward the role the LMS holds in instruction. While lack of time usually is categorized as a first-order barrier, the findings in this study suggest that lack of time can be what is called an *across external barrier*, which is impacted by both extrinsic and intrinsic barriers (Al Gamdi & Samarji, 2016; Rogers, 2000). The results highlight the value of offering easy-to-learn-to-use LMS platforms and knowledgeable technical support that is quick and easy to access so that faculty members can get support in a timely manner to help alleviate some of the issues caused by the lack-of-time barrier.

A third obstacle to effective use of LMS was *navigation issues*, particularly cumbersome navigation occasioned by too many clicks to access certain functions. Participants reported navigation issues in older LMSs, such as Blackboard and Moodle, which made it challenging to interact with the user interface. Faculty members did not perceive features as useful to support their instructional purposes, and they did not perceive ease-of-use features and interface design in the LMS. These findings confirmed previous research suggesting that navigation issues, such as poor interface design, was the barrier that negatively impacted faculty's LMS use (Al Meajel & Sharadgah, 2017). These findings also suggest that the first-order barriers of *lack of features* and *navigation issues* are identified external variables that influenced the two determinants, PU and PEOU, in the TAM (Davis, 1989). This is because *lack of features* and *navigation issues* can negatively affect one of the external variables, job relevance, resulting the impact to the two determinants, PU and PEOU.

Recently studies tended to show that students and faculty affect each other towards the intention to use LMS (Goh et al., 2014; Gierdowski & Galanek, 2020; Meajel

and Sharadgah, 2017). The descriptive statistical findings of this study show that *student's motivation to use an LMS* was on average a *minimal barrier* for faculty LMS adoption. Nevertheless, during the follow-up interview, one participant mentioned that she would not invest her time in learning features of an LMS if her students were not willing to use it.

The findings highlighted three second-order barriers to LMS use in higher education, including *comfort with learning how to use an LMS*, *beliefs about how learning happens*, and *pedagogical beliefs*. According to the results of the follow-up interviews, faculty members typically felt at ease learning how to use an LMS's capabilities. However, first-order obstacles like *time restraints* and the *LMS interface's ease of use* appeared to impact their readiness to adapt to and use new features. Again, this shows that external first-order obstacles may affect faculty members' intrinsic barrier of comfort level when utilizing an LMS (Al Gamdi & Samarji, 2016; Rogers, 2000).

The way that faculty members saw the elements of the LMS was significantly influenced by their conceptions of *how learning occurs*. Faculty found it hard to facilitate interactive discussion in an LMS as features supporting social interaction and collaboration were limited. This finding reflected previous research which suggested that faculty found that using features to facilitate communication and discussion in LMS did not work well compared to face-to-face meeting with students (Wichadee, 2015). The capabilities of an LMS could only partially replace in-person interaction, according to those who adhered to the social constructivist theory, which views learning as a social interaction process. Conversely, the LMS elements, particularly the use of quizzes to reinforce learning, were more likely to satisfy the instructional strategies of faculty

226

members who associated with behaviorism, who believed that learning occurs via practice and repetition.

Another notable barrier was *pedagogical beliefs*, which informed the PU of LMS in achieving intended teaching outcomes. Specifically, faculty members whose teaching philosophy emphasized collaboration and interaction found LMS platforms to be deficient in the requisite features for enabling adequate student engagement. However, they seemed to understand the limitations of an LMS in this aspect. The findings suggested that even though faculty were not able to find features in an LMS that supported their pedagogical approaches, they still used those basic and functional features to host course materials for students. This supports previous studies suggesting that faculty use LMS as a tool to manage course materials for its functionality and usefulness (Gierdowski & Galanek, 2020; Goh et al., 2014). The findings also suggested that learning theories and pedagogical approaches should be taken into consideration when designing an LMS (Ouadoud et al., 2017). Overall, the findings revealed that the perception and use of LMS platforms was influenced by multiple second-order barriers.

The results imply that first-order and second-order barriers significantly overlapped in the faculty use of an LMS. Extrinsic first-order barriers, including a lack of time, inadequate technical assistance, and interface design, impacted the intrinsic barrier of user comfort with an LMS (Al Gamdi & Samarji, 2016; Rogers, 2000). Faculty members' remarks on first-order barriers impacted their opinions about learning theories as they were more inclined to apply characteristics consistent with their applied learning theories. Similar to how LMS features are chosen and used, the teaching ideologies of faculty members affected those members' opinions on first-order barriers. The results

show that first-order and second-order barriers could prevent faculty from using LMS. These barriers frequently interacted, highlighting the difficulty of faculty adoption and usage of LMS in higher education settings.

Moreover, the second-order barriers related to *comfort level with figuring out how to use an LMS*, *beliefs about how learning happens*, and *pedagogical beliefs* highlighted the significance of providing support and training to faculty members. Overcoming these barriers requires initiatives that help faculty members become more familiar and comfortable with LMS features, all while aligning them with their pedagogical approaches. Training programs and resources can assist faculty members in adapting their instructional practices to leverage the potential of LMS platforms. The findings also emphasize the need to bridge the gap between LMS platforms and different theoretical perspectives on learning. Recognizing and accommodating various beliefs about knowledge acquisition, such as social constructivism and behaviorism, can guide the development of LMS features that effectively support diverse teaching philosophies. This can involve providing interactive features that facilitate interpersonal interactions or offering tools for practice and reinforcement. Furthermore, the challenges related to time constraints and technical support highlight the importance of providing adequate resources and support for faculty members. Ensuring timely and responsive technical support can minimize the frustrations caused by technical difficulties and reduce the burden on faculty members. Allocating sufficient time and resources for educators to familiarize themselves with advanced features can also enhance their adoption and effective use of LMS platforms.

The barriers identified in the current study have been reported by previous studies examining determinants of LMS use in various settings. In a study utilizing the TAM model as a framework for analyzing the utilization of LMS, Fathema et al. (2015) reported that training and the quality of the platforms moderated the adoption of the platforms by influencing the users' perceived efficiency. This stance was reiterated by AlQuadh (2014), who pointed out that technical support is an important positive determinant of the use of LMS. If faculty members reliably receive help from technical support staff, their PU and PEOU of the digital platforms is likely to increase, enhancing their likelihood of adopting the technology. Similarly, Al Meajel and Sharadgah (2017) reported that time restriction was an important extrinsic barrier for Blackboard use among faculty members, especially among those with large pre-existing workloads. According to Saleem et al. (2016), negative beliefs about the effectiveness of Moodle in enhancing learning was associated with rejection of the platform as a teaching tool. From a practical pedagogical perspective, these findings point to the most common problematic areas that hinder the acceptance of LMS in higher education. The fact that these barriers recurred in multiple studies suggests that they have constituently failed to be addressed, indicating an important policy and managerial gap in higher education in the country. Importantly, the findings predict potential obstacles that warrant targeted resolution measures to increase the utilization and impact of LMS in instructional settings. Overall, insufficient technical support, unfriendly user interface, missing features, and pedagogical beliefs are persistent barriers to the utilization of LMS in higher education. This study found that barriers (Ertmer, 1999) and adoption external factors (variables) in the TAM2 model (Venkatesh

& Davis, 2000) somewhat overlapped. This study supports Wheeler's (2018) research, which states that barriers and external factors of adoption should be combined.

Finally, based on the descriptive statistical analysis of faculty's self-reported online survey, the findings in this study did not show that faculty reported significant barriers, on average. There are two possible reasons to explain this finding. First, it could be that most participants in this study were not beginners at using an LMS. According to the survey results in this study, 74% of faculty had more than 4 years of experience using an LMS, while only 26% of faculty had 3 years or less experience using an LMS. This means that the majority of faculty have had experience using an LMS before. As faculty members become more comfortable with using an LMS, their focus on barriers could decrease (Rogers, 2000). Second, the survey data for this study was collected in Spring 2021. This was still the time of the COVID-19 pandemic, but faculty had probably already overcome many barriers to LMS integration at this time point compared to the emergency remote learning that began when the pandemic hit in March 2020.

7.7 RQ3a: What is the Relationship Between the Demographic Factors and Barriers?

This research question examined whether the demographic factors influenced faculty's barriers to technology integration. The demographic factors included: 1) LMS platforms, 2) gender, 3) age, 4) years of teaching experience, 5) years of using digital tools, and 6) years of using an LMS. I analyzed the online survey data through rank-

based non-parametric tests, including Mann-Whitney U tests and Kruskal-Wallis H tests, to identify if demographic factors influenced first-order and second-order barriers.

The findings of this study suggested that demographic factors influence faculty's perception of barriers to using an LMS in U.S. higher education. The data showed that LMS platforms and gender did not influence faculty's perception of barriers. However, age, teaching experience, years utilizing digital tools for teaching, and years using LMS for teaching all showed significant variations. When compared to faculty members aged 41–49, younger faculty members (those 40 years or younger) felt the first-order barrier of *hard to use across different types of devices (laptops, smartphones, tablets)* to be a greater issue. This shows that younger faculty members had higher expectations for the LMS's accessibility across different devices and might have trouble using it on diverse platforms. In addition, the findings suggested that, compared to faculty with 11 to 20 years of teaching experience, faculty with 10 years or less of teaching experience described the first-order barrier *hard to use across different types of devices* as a more severe issue. Collectively, these results underscored the noteworthy relationships among users' age, teaching experience, and utilization of LMS platforms.

Significant differences were also identified among faculty members' experience with digital tools, and years spent utilizing LMS platforms. The first-order barrier *lack of access to the LMS (e.g., unreliable internet connection or incompatible browser/device)* was statistically influenced by years of using digital tools for teaching, although the post hoc tests were not able to identify a significant difference between the groups. However, participants with 5 or fewer years of using digital tools for teaching found *navigation issues* and *lack of professional development about how to integrate LMS into instruction*

to be more problematic barriers and more difficult to overcome than those with 20 or more years of experience. This implies that faculty members less accustomed to utilizing digital tools may encounter more difficulties navigating an LMS and may need more assistance and training to integrate the LMS into their instruction. In contrast, among participants in the 16–20 years of experience group, the more important barrier was *lack of features*. Finally, faculty members with 3 or less years of experience with LMS reported that *confidence in using the LMS* was more important a barrier than participants with 7 to 9 years of experience did. This conclusion suggested that faculty members may need more confidence in properly using an LMS's capabilities if they have little experience using it. Altogether, the results highlighted the multifactorial determination of LMS utilization patterns.

These findings add to the body of knowledge on the barriers of integrating LMS into the classroom in U.S. higher education. They emphasize the significance of considering demographic factors when analyzing faculty members' LMS use barriers. The identified significant differences among demographic variables and barriers in LMS use may arise from group-specific characteristics that dictate how the platforms are perceived and used and the challenges that can arise. For instance, younger educators, who are typically more familiar with technology are also likely to use an LMS across different devices, may face specific difficulties in adapting to and utilizing LMS platforms across multiple devices. This finding underscores the importance of providing targeted support and training to meet the unique needs and challenges faced by younger faculty members. Moreover, faculty members with less experience with digital tools may require additional support and training to effectively navigate and integrate LMS

platforms into their instructional practices. Collectively, the results show the multifactorial nature of LMS utilization patterns, influenced by factors such as age, teaching experience, digital tool experience, and years spent utilizing LMS platforms. A thorough understanding of these associations can inform targeted support programs, training initiatives, and infrastructure improvements to enhance educators' utilization of LMS platforms. Importantly, higher education institutions can foster the effective use of LMS tools and promote inclusive and meaningful learning experiences for both faculty members and students by addressing the specific needs and challenges faced by different demographic groups.

There is little existing literature examining the relationship between barriers to LMS use and demographic factors in U.S. faculty, although some comparisons to foreign faculty can be made. Some of the patterns of barrier significance identified in the current study conformed with those reported in previous literature on the topic. According to Al Meajel and Sharadgah (2017), platform-specific navigational challenges are more likely to be significant among faculty with less teaching experience and those with more limited exposure to digital tools. The authors explained that instructors with more extensive teaching experience and experience using digital tools are more likely to have become familiarized with the LMS platforms or to have found ways to overcome inherent technical challenges, resulting in a lower significance of navigational barriers and confidence with the tools' use. As far as faulty members' age is concerned, Al Gamdi and Samarji (2016) found that there is no significant difference in perceiving external barriers to e-learning based on age. The finding in the present study did not agree with the previous research, as age and teaching experience impacted how faculty perceived this

specific first-order barrier. Interestingly, it is assumed that younger faculty are more tech-savvy as Millennials have grown up using technologies and should experience less of these types of technical issues. A possible reason to explain this finding is that, because younger faculty are more tech-savvy, they might use LMS across different types of devices more often; therefore, they are more likely to experience this type of issue compared to faculty who do not often use an LMS across different types of devices. This discrepancy from the literature calls for additional examination of the relationship between these variables, the findings of which can inform the practical implementations of an LMS in situations with instructors of varying ages. Importantly, these findings underscore the need to incorporate experienced faculty members in teams designed to champion the introduction of LMS, a modification that could enhance the ease of the technology's use.

The findings from RQ3 and RQ3a add to the body of knowledge on barriers to technology integration in education. They are consistent with earlier research emphasizing the complexity of barriers, including educational, technological, and individual variables (Al Meajel & Sharadgah, 2017). To effectively overcome these obstacles, the findings highlight the necessity for tailored support and professional development initiatives.

Educators can interpret these findings as proof that complex and variable demographic characteristics can influence barriers to technology integration. It is possible to build interventions and support systems to promote technology integration by thoroughly understanding the difficulties experienced by faculty members. Institutions, for instance, can modify their training plans and resource allocation to overcome the

uncovered barriers. This could entail delivering mentorship programs to boost confidence when using LMS, resolving specific concerns like feature availability, or offering training on LMS navigation.

These discoveries have important educational ramifications. Institutions can establish a climate that encourages successful technology integration by identifying the obstacles that faculty must overcome. The findings highlight the significance of continued professional development programs that consider faculty members' varied requirements and backgrounds. Additionally, the results show how professors, instructional designers, and tech support teams must work together to ensure that LMS platforms satisfy the changing needs of professors and students.

7.8 Recommendations for Implementation and Future Research

Findings from this study revealed the following implications for future research. First, research on technology adoption has been widely examined by applying the TAM and TAM2. Several external variables were added to the TAM2 and resulted in a very complex model due to a multitude of factors involved. It also uses complicated statistics such as structural equation models for data analysis. This study uses a qualitative method to explore faculty's LMS adoption. While quantitative analysis provides correlation results to explain whether external variables influence technology adoption, this study provides a different angle to explore faculty's LMS adoption through qualitative data. Future study should continue conducting qualitative studies to provide an in-depth view of technology adoption.

Second, I focused on exploring faculty LMS use in lieu of student LMS use. Most of the research on LMS use has been focused on students' perspectives, so this study contributed by presenting evidence regarding faculty's LMS adoption. Future research should continue studying faculty's LMS adoption, especially among faculty in U.S. higher education, as most research on faculty's LMS adoption was conducted outside of the United States and the results can be hard to apply to U.S. faculty.

Third, I applied the PICRAT model to examine how faculty used an LMS. While the PICRAT model is a newer technology integration model and has not been widely used in higher education settings, future research should evaluate technology integration in higher education through the PICRAT model, as this model examines both instructor and student relationship to the technology; also, the findings in this study found the PICRAT model is beneficial for instructors to examine LMS use themselves. Future research should also investigate how faculty could use the PICRAT model as a self-reflection tool for their LMS use.

Fourth, this study revealed that faculty's beliefs of learning theories influence their LMS use. Learning theories should be considered when designing an LMS to support faculty's pedagogical approaches and philosophies. Nevertheless, an LMS should be designed for instructors and students that support teaching and learning. Future research should examine whether features provided in an LMS support instructors' learning theories and pedagogical approaches.

Fifth, this study supported time as an across external barrier. First-order and second-order barriers can intertwine and influence each other. Perhaps some first-order and second-order barriers should be redefined. Future research should involve more

empirical studies and examine the relationship between the influences of first-order and second-order barriers.

Finally, external variables influenced technology adoption (e.g., TAM2) and barriers to technology seem to overlap at a certain level. Future studies should explore whether technology adoption and barriers to technology integration should be combined or kept separate as two research topics.

7.9 Summary

In this study, I explored the motivations behind faculty members' usage of learning management systems (LMS) in U.S. higher education, how they use LMS platforms, and the challenges they encounter when incorporating LMS into their instruction. The results shed light on faculty viewpoints and offer insightful information about the elements that affect LMS adoption and usage.

The main conclusions about the incentives for adopting an LMS among faculty members revealed that *hosting course materials*, *communicating with students*, *and university policies/requirements* were the most frequent drivers. LMS systems served as a central point for distributing course materials, notifying students via emails and announcements, and adhering to institutional norms by faculty members. Notably, one of the main justifications for implementing an LMS was not *facilitating learning activities*. These results imply that LMS systems are more commonly seen by faculty members as administrative and logistical tools than as instruments for improving the learning experience.

Additionally, it was discovered that demographic variables, including age, teaching experience, digital tool experience, and LMS experience, impacted how and why faculty members use LMS systems. While there were notable differences between groups, hosting course materials, communicating with students, and overseeing assignments stood out as universal strategies across all ages and backgrounds. However, some groups were more likely to rely on LMS platforms for grading reasons than others, including younger faculty members, those with less experience teaching, and those who needed more exposure to digital tools. These results imply that faculty members' technology comfort, familiarity levels, and educational beliefs may influence how they use LMS systems.

The study identified first-order and second-order barriers when examining the barriers to LMS integration. First-order barriers included time restrictions, a lack of functionality in LMS systems, and navigational challenges. Faculty members expressed concerns about the absence of certain functionality, the need for more user-friendly interfaces, and the limited usefulness across various platforms, even though they did not view these restrictions as major challenges. Second-order barriers included faculty members' comfort with learning how to use LMS features, pedagogical views, and beliefs about how learning occurs. Participants with student-centered teaching philosophies or social constructivist beliefs frequently found that LMS platforms in general were not suited to their instructional strategies. These data demonstrate how institutional and individual viewpoints influence faculty members' attitudes toward LMS systems.

Several interesting patterns emerged when demographic characteristics and barriers were compared. Age and teaching experience appeared as significant determinants, while LMS platforms and gender had little effect on identifying barriers to technology integration. The first-order barrier *hard to use across different types of devices* was reportedly perceived as more difficult by younger faculty members and those with less teaching experience. Additionally, the faculty members' impression of first-order barriers relating to navigational challenges, a lack of features, restricted access to the LMS, and the requirement for professional development appeared to be influenced by their experience using digital tools for teaching. Additionally, professors with less experience utilizing LMS for teaching showed increased skepticism or lack of confidence in their ability to use LMS platforms for teaching successfully.

The study's findings indicate that while faculty members appreciate the advantages of LMS platforms for carrying out administrative duties and disseminating information, there needs to be more integration of higher-level uses that encourage interactive learning and involvement. With little use of interactive or transformative capabilities, most faculty members primarily use LMS platforms at the Passive-Replacement (PR) level. The impediments that have been found, particularly those that concern usability, feature limits, and faculty comfort, emphasize areas that could use improvement and support to increase faculty adoption of LMS platforms and involvement.

The PICRAT model offers instructors a helpful instrument for reflecting on their technology integration strategies and identifying potential obstacles. It nudges professors to investigate how to shift towards more transformative uses of technology in their

teaching. It pushes faculty members to think about how they and their students use technology. Faculty members can choose how to integrate technology efficiently and improve student learning experiences by recognizing the barriers and utilizing the insights from the PICRAT model.

This study sheds light on the factors that influence faculty members' use of LMS platforms in U.S. higher education, including their motives, usage patterns, and barriers. The results highlight the need for extensive training, professional development support programs, better designed LMS platforms that address the issues of faculty members, support effective pedagogical strategies within LMS platforms, and make it easier to integrate cutting-edge features to improve student engagement and learning outcomes. Institutions can better support their faculty in adopting and utilizing an LMS to build more effective and engaging learning environments by identifying the factors that affect faculty members' use of LMS platforms.

APPENDIX A

INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL

UMassAmherst

Human Research Protection Office

Mass Venture Center
100 Venture Way, Suite 116
Hadley, MA 01035
Telephone: 413-545-3428

LETTER OF EXEMPT DETERMINATION

Date: February 22, 2021
To: Professor Torrey Trust and Ming-hui Tai, College of Education
From: Professor Lynnette Leidy Sievert, Chair, University of Massachusetts Amherst IRB

Protocol Title: *Using TPACK Model to Understand Technology Integration With Learning Management Systems in Higher Education*
Protocol ID: 2509
Review Type: EXEMPT -NEW
Category: 2
Review Date: 02/22/2021
No Continuing Review Required
UM Award #:

The Human Research Protection Office (HRPO) has reviewed the above named submission and has determined it to be EXEMPT from the federal regulations that govern human subject research (45 CFR 46.104)

Note: This determination applies only to the activities described in this submission. All changes to the submission (e.g. protocol, recruitment materials, consent form, additional personnel), must be reviewed by HRPO prior to implementation.

A project determined as EXEMPT, must still be conducted in accordance with the ethical principles outlined in the Belmont Report: respect for persons, beneficence, and justice. Researchers must also comply with all applicable federal, state and local regulations as well as UMass Amherst Policies and procedures which may include obtaining approval of your activities from other institutions or entities. All personnel must complete CITI training.

Consent forms and study materials (e.g., questionnaires, letters, advertisements, flyers, scripts, etc.) - Only use the consent form and study materials that were reviewed by the HRPO.

Final Reports - Notify the IRB when your study is complete by submitting a Close Request Form in the electronic protocol system.

Serious Adverse Events and Unanticipated problems involving risks to participants or others - All such events must be reported in the electronic system as soon as possible, but no later than five (5) working days.

Annual Check In - HRPO will conduct an annual check in to determine the study status.

Please contact the Human Research Protection Office if you have any further questions. Best wishes for a successful project.

UMassAmherst

Human Research Protection Office

LETTER OF EXEMPT DETERMINATION

Date: February 9, 2022

To: Professor Torrey Trust and Ming-hui Tai, College of Education

From: Professor Lynnette Leidy Sievert, Chair, University of Massachusetts Amherst IRB

Protocol Title: *Using TPACK Model to Understand Technology Integration With Learning Management Systems in Higher Education*
Protocol ID: 2509
Review Type: Exempt – Amendment
Review Date: 02/09/2022
No Continuing Review Required

The Human Research Protection Office (HRPO) has reviewed the above named submission and has determined it to be EXEMPT from the federal regulations that govern human subject research (45 CFR 46.104)

Note: This determination applies only to the activities described in this submission. All changes to the submission (e.g. protocol, recruitment materials, consent form, additional personnel), must be reviewed by HRPO prior to implementation.

A project determined as EXEMPT, must still be conducted in accordance with the ethical principles outlined in the Belmont Report: respect for persons, beneficence, and justice. Researchers must also comply with all applicable federal, state and local regulations as well as UMass Amherst Policies and procedures which may include obtaining approval of your activities from other institutions or entities. All personnel must complete CITI training.

Consent forms and study materials (e.g., questionnaires, letters, advertisements, flyers, scripts, etc.) - Only use the consent form and study materials that were reviewed by the HRPO.

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Annual Check In - HRPO will conduct an annual check in to determine the study status.

Please contact the Human Research Protection Office if you have any further questions. Best wishes for a successful project.

ONLINE SURVEY AND CONSENT FORM

Intro 1.

Thank you very much for your willingness to participate in this survey.
This survey is intended for faculty working in higher education settings in the United States.

Are you currently a faculty working in a higher education setting in the United States?

○ Yes
○ No

Consent.

Online Survey Consent Form

My name is Minghui Tai. I am a doctoral student at the University of Massachusetts Amherst. I am inviting you to participate in a research study titled "**Using the TPACK Model to Understand Technology Integration with Learning Management Systems in U.S. Higher Education.**"

1. Purpose of the Study
The purpose of this study is to understand how and why faculty use learning management systems (LMS) and explore factors and barriers that influence faculty **LMS use in U.S. higher education**. The results from this survey may be included in the researcher's dissertation and may be included in manuscripts submitted to professional journals for publication.

2. Online Survey
If you agree to take part in this study, you will be asked to complete an online survey through Qualtrics. This online survey includes two parts: 1) main study and 2) free drawing sign-up form.

Part 1: Main Study
This part of the survey includes four sections: The first section will ask about your demographic information, including your gender, age, discipline of expertise, teaching experience, courses you are teaching or have taught. The second section will ask about your use of LMS. The third section will ask about barriers of LMS integration. The fourth section will ask you to reflect upon the content you teach, your pedagogy, and your use of technology. **The survey should take approximately 12 to 15 minutes to complete.**

At the end of the Part 1: Main study, you will be asked to leave your institutional email address if you are willing to be contacted to participate in a follow-up interview. Please note: You are not required to participate in the follow-up interview, it is on a voluntary basis.

The follow-up interview will be scheduled individually and will be hosted in Zoom. The follow-up interview will be audio-recorded with your permission. You may be asked to showcase features that you use in LMS through the screen share feature within Zoom. If you use the screen share feature, this will only be video-recorded with your permission. The follow-up interview audio will be transcribed.

Part 2: Free Drawing Sign-up Form
This part of the survey will ask you to leave your name and institutional email address if you would like to enter a free drawing for the chance to win one prize of a **$150 Amazon.com Gift Card** for participating in this survey. Participation in the free drawing is completely voluntary and you do not need to give your name and institutional email address if you do not want to be entered in the drawings.

3. Benefits of Participation
You may not directly benefit from this research. However, I hope that your participation in this study will provide you with an opportunity to share your experiences of LMS use. The information you share will help to improve the design of faculty development initiatives regarding LMS integration into instruction. Results of your participation may be beneficial to other faculty at your institution and at other institutions.

4. Potential Risks of Participation and Confidentiality
I believe that there are no known risks associated with this research study; however, as with any online related activity, such as surveys, the risk of a breach of confidentiality is always possible. To the best of my

ability, your answers in this study will remain confidential. The following procedures will be used to protect the confidentiality of your study records: The survey will be distributed in an anonymous link created in Qualtrics and is set to anonymize responses. Your name, IP address, institution you teach, and other identifying information will not be collected. At the end of Part 1: Main study, you will be asked to leave your institutional email address if you are interested in participating in a follow-up interview. If you choose to provide your institutional email address, your survey responses may no longer be anonymous to the researcher. However, no names or identifying information will be included in any publications or presentations based on these data, and your responses to this survey will remain strictly confidential. 2) Following the end of Part 1: Main study, you will be directed to Part 2: Free drawing sign-up form. You can leave your name and institutional email address if you would like to enter a free drawing for the chance to win a prize. The data for part 1 and part 2 of the survey are kept separately. This way, the survey responses in Part 1 and your name and email address in Part 2 are not linked to each other. 3) Your survey responses will be stored initially with Qualtrics in a password protected electronic format. Data will later be downloaded and stored in a password-protected folder. 4) Any computer hosting such files will also have password protection to prevent access by unauthorized users; 5) Only the researcher will have access to the passwords. At the conclusion of this study, I may publish the findings, however, information will be presented in summary format and you will not be identified in any publications or presentations. All data will be destroyed 3 years after the close of the study.

5. Compensation

Online Survey:
There will be a free drawing for the chance to win one prize of a **$150 Amazon.com Gift Card** for taking this online survey. Participants who complete the online survey **by May 18, 2021** and leave their institutional email addresses in Part 2: Free Drawing Sign-up Form are automatically entered in the free drawing for a chance to win one prize of a $150 Amazon.com Gift Card. The winner will be drawn with a third-party witness present and will be notified via their valid institutional email address.

Follow-up Interview:
Participants who are interested in participating in an additional follow-up interview can leave their institutional email addresses at the end of the survey in Part 1: Main Study. The interview will last 60 to 90 minutes. Participants will need to sign another consent form for the interview before the interview starts. Participants who are selected to participate in the follow-up interview will receive a **$100 Amazon.com Gift Card** upon completion of the interview. Immediately after the interview, a $100 Amazon.com Gift Card will be sent to the participants via the institutional email address they provide. If participants are not able to complete the entire interview for any reason, they will be compensated $1 Amazon.com Gift Card/minute.

6. Voluntary Participation
Your participation in this study is completely voluntary and you can withdraw at any time. You do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate. You are free to skip any survey questions that you choose.

Contact
If you have questions about this project or if you have a research-related problem, you may contact the researcher(s), Minghui Tai at mtai@umass.edu or you may contact the faculty sponsor Dr. Torrey Trust at torrey@umass.edu. If you have any questions concerning your rights as a research subject, you may contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at (413) 545-3428 or humansubjects@ora.umass.edu.

By clicking "I Agree" below you are indicating that you are at least 18 years old, and are currently a faculty working in a higher education setting in the Unites States. You have read this consent form and agree to participate in this research study. Please print a copy of this page for your records.

○ I Agree

○ I Do Not Agree

Q1. Which semester did you teach **most recently**?

○ Spring 2021

○ Fall 2020

○ Spring 2020

○ Fall 2019

○ Other [_____]

Q2.

What courses did you teach in **the most recent semester,** what type of courses were they, and what Learning Management System (LMS) did you use?

Type of courses	Definition
In-person	traditional face-to-face instruction
Emergency Remote Teaching	delivered instruction from a distance due to the COVID-19 pandemic
Hybrid-Flexible or HyFlex	a mix of in-person and remote/online teaching
Online	course was fully online prior to/unrelated to the COVID-19 pandemic

	Type of Courses				Did you use a Learning Management System in this course?		What Learning Management System did you use in this course? (e.g. Moodle, Blackboard Learn, Canvas)
	In-Person	Emergency Remote	HyFlex	Online	Yes	No	LMS Name
1. Course Title: [____]	☐	☐	☐	☐	○	○	[_____]
2. Course Title: [____]	☐	☐	☐	☐	○	○	[_____]
3. Course Title: [____]	☐	☐	☐	☐	○	○	[_____]
4. Course Title: [____]	☐	☐	☐	☐	○	○	[_____]
5. Course Title: [____]	☐	☐	☐	☐	○	○	[_____]

Q3. To which gender identity do you most identify?

○ Man

○ Woman

○ Prefer to self-describe as [_____]

Q4. What is your age?

○ 18 - 24

○ 25 - 29

○ 30 - 34

○ 35 - 40

○ 41 - 44

○ 45 - 49

○ 50 - 54

○ 55 - 59

○ 60 +

Q5. What **academic college** are you a member of and what is your **discipline of expertise?**

For example:
Academic college: College of Education
Discipline of expertise: Children, Families, & Schools.

Academic College:	
Discipline of expertise:	

Q6. How many years of teaching experience do you have?

○ < 1 year

○ 1- 5 years

○ 6- 10 years

○ 11- 15 years

○ 16- 20 years

○ 20 + years

Q7. How many years of experience do you have teaching with digital tools (e.g., PowerPoint, Google Apps for Education, social media, animated tutorials, web 2.0 tools)?

○ < 1 year

○ 1- 5 years

○ 6- 10 years

○ 11 -15 years

○ 16- 20 years

○ 20 + years

Q8. When the COVID-19 pandemic started in **March 2020**, institutions made the decision to move courses remotely, did you

○ Start using an LMS

○ Use an LMS more often than before the pandemic

○ Use an LMS the same amount

LMS 1. In general, which Learning Management System (LMS) did you **utilize most often in the most recent semester that you taught**?

○ Moodle

○ Blackboard Learn

○ I used another LMS: [   ]

246

○ I did not use an LMS

○ Prefer not to answer

LMS 2. How many years of experience do you have using **this LMS**?

○ < 1 year

○ 1-3 years

○ 4-6 years

○ 7-9 years

○ 10 years +

LMS 3. **Why** did you use **this LMS** in the most recent semester that you taught? (e.g., host course materials, communication with students, university policy required)

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```

LMS 4. Please describe **how** you used **this LMS** in the most recent classes you taught.

```


```

LMS 5. In general, how would you rate **usefulness** of this LMS for your teaching in the most recent semester that you taught?

○ Not useful at all

○ Slightly useful

○ Moderately useful

○ Very useful

○ Extremely useful

LMS 6. In general, did you find this LMS was **easy to use** in the most recent semester that you taught?

○ Not easy to use at all

○ Slightly easy to use

○ Moderately easy to use

○ Very easy to use

○ Extremely easy to use

LMS 7a. Which of the following **Moodle features** did you use in the most recent course you taught?

	Used in the most recent course I taught?	
	Yes	No
Announcements	○	○
Assignments	○	○
Chat	○	○
Choice	○	○
Database	○	○
External Tool	○	○
Feedback	○	○
Forum	○	○
Glossary	○	○
Grades	○	○
Lesson	○	○
Quiz	○	○
SCORM	○	○
Survey	○	○
Wiki	○	○
Workshop	○	○

LMS 7a1. Other Moodle features or plugins activities that I used in the most recent course I taught:

LMS 7b. Which of the following **Blackboard Learn features** did you use in the most recent course you taught?

	Used in the most recent course I taught?	
	Yes	NO
Announcements	○	○
Assignments	○	○
Blackboard Collaborate	○	○
Blogs	○	○
Chat	○	○
Course Content	○	○
Course Messages	○	○
Discussions	○	○
Forum	○	○
Feedback	○	○
Glossary	○	○
Google Meet	○	○
Grading	○	○
Groups	○	○

248

Journals	○	○
Organizations	○	○
Quizzes	○	○
SCORM	○	○
Surveys	○	○
Tests	○	○
Wikis	○	○
Workshop	○	○

LMS 7b1. Other Blackboard Learn features or plugins activities that I know how to use and used in the most recent course I taught

LMS 7c. Which **features** in the LMS did you use in the most recent course you taught?
(e.g., discussion forum, gradebook, announcements, uploading assignments)

Barriers 1.
Research shows that faculty often experience barriers when using digital technologies.
Please indicate to what extent each of the following is a **barrier** to your use of **LMS** for instruction.

	Not a Barrier	Minimal Barrier	Moderate Barrier	A Significant Barrier
Lack of time	○	○	○	○
Lack of technical support from my institution	○	○	○	○
Lack of access to the LMS (e.g. Unreliable Internet connection or incompatible browser/device)	○	○	○	○
Student lack of access to the LMS	○	○	○	○
Hard to use across different type of devices (laptop, smartphone, tablet)	○	○	○	○
Student data privacy risks in LMS	○	○	○	○
Navigation issues in LMS	○	○	○	○
Lack of features in LMS (e.g. lack of collaborative learning tools, lack of customizable layout, lack of customizable reporting)	○	○	○	○
Lack of professional development about how to integrate LMS into instruction	○	○	○	○
My students' motivation to use the LMS	○	○	○	○
My comfort level with figuring out how to use the LMS	○	○	○	○
My confidence in using the LMS for teaching	○	○	○	○
My motivation to use the LMS	○	○	○	○
My pedagogical beliefs (teaching philosophy)	○	○	○	○
My beliefs about how learning happens	○	○	○	○
My attitude towards using the LMS	○	○	○	○

Q1:PkCkPck. You're almost done with the Survey!

249

To what extent do you agree or disagree with the following statements?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. I have a clear understanding of pedagogy (e.g., designing instruction, assessing student's learning).	○	○	○	○	○
2. I am familiar with a wide range of practices, strategies, and methods that I can use in my teaching.	○	○	○	○	○
3. I know how to design inclusive and accessible learning for diverse student needs.	○	○	○	○	○
4. I have a comprehensive understanding of the curriculum I teach.	○	○	○	○	○
5. I am familiar with the common preconceptions and misconceptions that influence student learning in my discipline.	○	○	○	○	○
6. I stay abreast of new research related to my discipline in order to keep my own understanding of my discipline updated.	○	○	○	○	○
7. I understand that there is a relationship between content and the teaching methods used to teach that content.	○	○	○	○	○
8. I can provide multiple representations of the content in the form of analogies, examples, demonstrations, and classroom activities.	○	○	○	○	○
9. I can adapt content-specific instruction to students' abilities, prior knowledge, preconceptions, and misconceptions.	○	○	○	○	○

Q2:TkTpkTckTpck.
This is the last set of questions!

To what extent do you agree or disagree with the following statements?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. I am familiar with a variety of hardware, software, and technology tools that I can use for teaching.	○	○	○	○	○
2. I know how to troubleshoot technology problems when they arise.	○	○	○	○	○
3. I keep up with new changes in technology teaching and learning.	○	○	○	○	○
4. I understand how teaching and learning change when certain technologies are used.	○	○	○	○	○
5. I understand how technology can be integrated into teaching and learning to help students achieve specific pedagogical goals and objectives.	○	○	○	○	○
6. I know how to be flexible with my use of technology to support teaching and learning.	○	○	○	○	○
7. I can select and integrate technological tools appropriate for use in my discipline (or content area).	○	○	○	○	○
8. I understand how the choice of technologies allows and limits the types of content that can be taught.	○	○	○	○	○
9. I understand how content decisions can influence the types of technology that can be integrated into my instruction.	○	○	○	○	○
10. I can use appropriate instructional strategies to teach specific content topics with technology.	○	○	○	○	○
11. I can use teaching methods that are technology-based to teach content and provide opportunities for learners to interact with ideas.	○	○	○	○	○
12. I understand what makes certain concepts difficult to learn for students and how technology can be used to leverage that knowledge to improve student learning.	○	○	○	○	○

250

Interview.
You are Done with the Survey! Before you submit the survey, would you be willing to participate in a follow-up interview?

If you are selected to participate in the follow-up interview, you will receive <mark>a $100 Amazon.com Gift Card</mark> for compensation.

If you are interested in participating in the follow-up interview, please leave your valid institutional email address below.

My institutional email address:

_____

APPENDIX C

FOLLOW-UP INTERVIEW CONSENT FORM

Consent Form for Follow-up Interview Participation in a Research Study
University of Massachusetts Amherst

Researcher(s):	Minghui Tai, (Faculty Sponsor: Dr. Torrey Trust)
Study Title:	Using TPACK Model to Understand Technology Integration with Learning Management Systems in Higher Education

1. PURPOSE OF THE STUDY

The purpose of this study is to understand how and why faculty use learning management systems (LMS) and explore factors and barriers that influence faculty LMS use in U.S. higher education. The results from this survey may be included in the researcher's dissertation and may be included in manuscripts submitted to professional journals for publication.

2. SEMI-STRUCTURED INTERVIEW

If you agree to take part in this study, you will be asked to answer questions regarding your experiences with LMS use, adoption, barriers, and implementation. In addition, you will be asked about your experiences with teaching, pedagogies, and LMS use. During the interview, you may also be asked to demonstrate features you use in LMS. The interview will be hosted in Zoom and will be audio-recorded, with your permission. If you are asked to demonstrate features you use in LMS; with your permission, this section will be video recorded. However, in order to minimize unnecessary identifiable information, you will be asked to turn off the camera in Zoom first but leave the audio (microphone) on and then share your screen with the researcher to showcase the features you use in LMS during video recording process. The interview is expected to last up to 1-1.5 hours. You may be contacted in the future for follow-up but only with your permission. You may skip any question you feel uncomfortable answering. The follow-up interview will be transcribed.

3. BENEFITS OF PARTICIPATION

You may not directly benefit from this research; however, we hope that your participation in this study will provide you with an opportunity to share your experiences of LMS use with the researcher. The information you share will help to improve the design of faculty development initiatives regarding LMS integration into instruction. Results of your participation may be beneficial to other faculty at your institution or at another institution.

4. POTENTIAL RISKS OF PARTICIPATION AND CONFIDENTIALITY

We believe there are minimal risks associated with this research study. Please note that your responses will be used for research purposes only and will be strictly confidential. Your institution will not be able to examine your individual responses. However, a risk of breach of

252

confidentiality is always possible. To the best of our ability, your answers in this study will remain confidential. The following procedures will be used to protect the confidentiality of your study records: 1) All electronic files (audio recordings, video recordings, and digital transcriptions) containing identifiable information will be password protected. 2) Any computer hosting such files will also have password protection to prevent access by unauthorized users. 3) Only the researchers will have access to the passwords. 4) Any transcribed notes will be kept in a locked file cabinet.

At the conclusion of this study, the researchers may publish their findings. Information will be presented in summary format and you will not be identified in any publications or presentations. All data will be destroyed 3 years after the close of the study.

5. COMPENSATION

You will receive a $100 Amazon e-gift card upon completion of the interview. Immediately after the interview, a $100 Amazon e-gift card will be sent to you via the valid institutional email address you provided. If you are not able to complete the entire interview for any reason, you will be compensated $1 Amazon e-gift card/minute. You may be asked to continue completing the interview at a later time with your permission if for any reason the interview cannot be completed.

6. VOLUNTARY PARTICIPATION

Your participation in this study is completely voluntary and you can withdraw at any time. You do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate. You may choose not to answer any specific questions you do not want to answer and still remain in the study.

7. Contact

If you have questions about this project or if you have a research-related problem, you may contact the researcher(s), Minghui Tai at mtai@umass.edu or you may contact the faculty sponsor Dr. Torrey Trust at torrey@umass.edu. If you have any questions concerning your rights as a research subject, you may contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at (413) 545-3428 or humansubjects@ora.umass.edu.

8. SUBJECT STATEMENT OF VOLUNTARY CONSENT

When signing this form, I am agreeing to voluntarily enter this study and I am indicating that I am at least 18 years old. I have had a chance to read this consent form, and it was explained to me in a language which I use. I have had the opportunity to contact the researcher via e-mail at mtai@umass.edu. I have been informed that I can withdraw at any time. A copy of this signed Informed Consent Form has been given to me.

IRB OFFICE USE ONLY

University of Massachusetts Amherst-IRB
Protocol #: 2509
IRB Signature: _Nancy C. Smith_

Participant Signature: _____   Print Name: _____   Date: _____

By signing below, I indicate that the participant has read and, to the best of my knowledge, understands the details contained in this document and has been given a copy.

Signature of Person _____   Print Name: _____   Date: _____
Obtaining Consent

APPENDIX D

FOLLOW-UP INTERVIEW PROTOCOL

Interviewee: _____

Date: _____

<u>Script:</u>

Hello! My name is Minghui Tai. I am a graduate student from the College of Education at the University of Massachusetts, Amherst conducting my doctoral dissertation. Thank you for your participation and taking the time meeting with me today. The purpose of this interview is to understand more about how and why you use a Learning Management System. Thank you for completing the surveys we sent you previously, and this is a follow-up interview. I have all the information you gave us in the online survey and will mainly be asking you follow-up questions on some of your responses. It will take about 60-90 minutes. If you don't mind, I would also like you to show me one of your courses on Moodle/Blackboard/Canvas and walk me through the features you use. I would also like your permission to record this interview in Zoom and video record your computer screen when you are showing me your course on Moodle/Blackboard Learn/Canvas, so I am accurately documenting the information you share with me. Your responses are confidential. Your participation in this interview is completely voluntary. If at any time you need to stop, take a break, please feel free to let me know. You may also withdraw this interview at any time if you don't want to continue. Before we start, I would like to make sure you have signed the consent to participate in this study.

Do you have any questions or concerns before we begin? Then, with your permission, we will begin the interview.

Research Questions	Survey Questions	Potential semi-structural Interview Example Questions (Follow-up based on survey questions)
1. Why do faculty use an LMS in U.S. higher education? 2. How do faculty use an LMS in	Part 2: LMS Use	• You mentioned _____ is the reason why you use Moodle/Blackboard Learn/Canvas in the survey, could you tell me more about it? How is that? • You described how you use_____ (features in Moodle/Blackboard Learn/Canvas) in the survey. That

U.S. higher education?		sounds very interesting. Would you mind showing me one of your courses on Moodle/Blackboard Learn/ Canvas and walk me through the features you use for your teaching? 1. What is the purpose for you to choose to use this individual feature? (Replace, Amplify, Transform?) 2. How do you expect students to use this individual feature that you set up for their learning? (Passive, Interactive, Creative?) • I am interested in what factors influence faculty use of the different features in Moodle/Blackboard Learn/Canvas. In the survey, you indicated (factors) were the main factors influencing your use of Moodle/Blackboard Learn/Canvas. Can you tell me more about how (factors) shapes your use of Moodle/Blackboard Learn/Canvas features? • How might you use Moodle/Blackboard Learn/Canvas differently if __ (factors did not exist)? • In the survey, you responded Moodle/Blackboard Learn/Canvas is not easy to use. Could you tell me more about it? • In the survey, you responded Moodle/Blackboard Learn/Canvas is not easy to use. Could you tell me more about it?
3. What barriers influence faculty use of LMS in U.S. higher education	Part 3: Barriers to technology Integration	First-order barriers: • Could you tell me more about which features in Moodle/Blackboard Learn/Canvas that you are really interested to use but you hesitate to learn due to it being **time**-consuming? • How is it different regarding the **time** spent from planning and creating courses in Moodle/Blackboard Learn/Canvas versus traditional classroom? • Can you give me examples of what

		happened and why it happened of not having enough **time** to use Moodle/Blackboard Learn/Canvas during a class period?
		• What might be the reasons that made you have no **assess** to Moodle/Blackboard Learn/Canvas?
		• Could you talk more about how much **training** you got for using Moodle/Blackboard Learn/Canvas?
		• You indicated that "lack of time" is a moderate barrier to your use of Moodle. Can you tell me more about how lack of time influences your use of Moodle?
		• Please tell me more about how training you got influence your use of Moodle.
		• Please tell me more about how **technical support** influence your use of Moodle.
		• How does **pedagogical support** influence your use of Moodle/Blackboard Learn/Canvas?
		• How does **professional development** resources influence your use of Moodle?
		• Please tell me more about how **internet reliability** issue influences your use of Moodle.
		• How does students' lack of **accessibility to Moodle** impact your use of this system?
		• Do you feel that your **students** like Moodle/Blackboard Learn/Canvas? Tell me more about it.
		• Tell me more about which features do your **students** like the best in Moodle/Blackboard Learn/Canvas?
		• How does other **faculty's use** of Moodle/Blackboard Learn/Canvas influence your use of this learning management system?
		• Could you tell me more about why different **types of devices** influence your use of Moodle/Blackboard

257

		Learn/Canvas? (e.g., content layout doesn't show correctly in different devices; students are easy distracted by phone calls and texts when using Moodle on smartphone.)

Learn/Canvas? (e.g., content layout doesn't show correctly in different devices; students are easy distracted by phone calls and texts when using Moodle on smartphone.)

- Tell me more about it is **not intuitive when navigating** Moodle/Blackboard Learn/Canvas? Could you give me some examples?
- How does the **online security issues** impact your use of Moodle?
- Tell me more about which **features** you would like to use but they are not in Moodle/Blackboard Learn/Canvas currently?
- Tell me more about **features** you would like they are added or improved in Moodle/Blackboard Learn/Canvas in the future. How would you use these **features** and how would these features facilitate your teaching?

Second-order barriers:

- What might be possible reasons to **discourage** you to use Moodle/Blackboard Learn/Canvas?
- Tell me more about why you feel Moodle/Blackboard Learn/Canvas is **not useful** for your teaching?
- Could you tell me more about why you said you **don't know how to use Moodle/Blackboard/Canvas**?
- Tell me more about possible obstacles that affect your ability to **keep up with the pace of technology change**.
- Could you show me the examples of your lesson plans that are **hard to incorporate** into Moodle/Blackboard Learn/Canvas? Why is that?
- Could you tell me more about why you **don't feel comfortable to integrate**
- Moodle/Blackboard Learn/Canvas into

		your instruction?
		• Could you show me examples of why **the content area you teach does not fit well** to use Moodle/Blackboard Learn/Canvas? How do you present your content area? What other tools do you use?
		• Could you tell me more about the **difficulties when you design and manage courses using Moodle/Blackboard Learn/Canvas**?
		• Could you tell me more about why Moodle/Blackboard Learn/Canvas are not **efficient** for your teaching? What are your approaches to make your teaching more efficient? What are other tools you use?
		• Could you tell me more about why using Moodle/Blackboard Learn/Canvas doesn't **improve your teaching**? What are your approaches if you ever still want to improve your teaching when using Moodle/Blackboard Learn/Canvas?
		• How do you define **student learning**? How do you assess student learning? Could you tell me more why Moodle/Blackboard Learn/Canvas doesn't fit your beliefs about student learning?
		• What are your approaches to **evaluate or understand students' learning**? Could you tell me more about why Moodle/Blackboard/Canvas is hard to evaluate or assess students' learning? Could you show me and describe to me more about how you use **other software or technological tools for your teaching**?
	Part 4: TPACK Framework Survey Questions	**Pedagogical Knowledge (PK):** 1. Please describe your approaches that how you adapt methods, strategies for

		your teaching. 2. Tell me more about how you do you assess students' learning. 3. Tell me more how you design your teaching for diverse student needs? **Technological Knowledge (TK)** 1. Tell me more about how you keep up with new technological tools. 2. You mentioned in the survey that you always ask your colleagues for troubleshooting technological problems in Moodle/Blackboard Learn/Canvas. Could you tell me more about it? **Content Knowledge (CK)** 1. Tell me more about how you keep the content/knowledge you teach updated. 2. Tell me more about how you design your curriculum. **Pedagogical Content Knowledge (PCK)** 1. Tell me more about how you adapt your teaching methods and materials for students with different level of prior knowledge. 2. Could you briefly describe your teaching philosophy? 3. Could you tell me more about what your approaches are to design courses in order to meet the needs from a different variety of students? What are obstacles to design courses to meet needs from a different variety of students in Moodle/Blackboard Learn/Canvas.

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Technological Pedagogical Knowledge (TPK)

1. Could you tell me more about how do you use Moodle/Blackboard Learn/ Canvas to help students achieve their learning goals?
2. Tell me more about how the features you choose to use in LMS could change your teaching.
3. Could you describe or give me some examples of flexibility of using technology to support your teaching?

Technological Content Knowledge (TCK)

1. You described an example of how you use features in Moodle/Blackboard Learn/Canvas to deliver your course. Could you tell me more about how you use this/these_____ (features) to deliver course content/ activities /assessment?

Technological Pedagogical Content Knowledge (TPCK)

1. Tell me more about how the specific features you choose in LMS, instructional strategies, and learning goals all fit together to facilitate your teaching.
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Survey data analysis
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Follow up questions based on survey analysis.

Example of follow-up questions could be like this:

1. Based on your survey answers, it seems that you are not motivated to use Moodle because you don't have time to learn each
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		feature and you found it is hard and time-consuming to design course content in Moodle. The feature that you only used for the course is uploading of the course syllabus because it did not take too much time to do it. However, your students like to use Moodle; what is your approach to adapt your course design in order to meet students' preferences?

Thank & wrap up:

Any thought you would like to share before we end this interview?

Thank you so much for your participation and time!

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267

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