Effects of Independent Technology Use on Learning Management Systems

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Abstract

This mix-method research study aims to explore the user errors that occur when students use learning management systems (LMS) in a school-mandated setting, and analyzes whether or not experience with popular websites that offer, at times, more intuitive user interfaces, hinders students in their usage of educational software. The study will collect frequency data about the students' use of websites in their personal lives, and then students will be undergo an observation where the researcher will total the number of technical difficulties they experience during an e-learning assignment. The researcher will then find the mean for each frequency group, and compare the mean number of errors across the groups to see if there is a statistical difference between those that frequently use the popular websites, and those with minimal experience with those tools.

Keywords: learning management system, LMS, user interface, user error

Introduction

The school is an ever-evolving place, and the technologies that schools use, are changing just as rapidly. Just a few short years ago, battles were waged over computer lab space and other fairly mundane technology resources the schools had to offer, and educators met in panicked clusters to discuss the problems they were having with the emergence of smart phones. In some schools across the country, those debates may still be going on, but in many other school districts, the debate is over and technology now predominates lesson planning. From out of school Twitter chats, to Fake Facebook wall posts, assignments such as these harness the power of the websites are familiar with in an attempt to connect to students via the interfaces they already use. For educational software developers, the challenge lies in keeping up with these technologies and creating a product that rivals the polished look and feel of software from some companies that have the biggest research and development budgets in the world. The question remains for education software innovators everywhere: what makes students adopt a learning management system as a viable educational tool? The answer to this question may be in the expectations between what students use at home, and the inconsistencies between those intuitive interfaces, and the software students have to use for educational purposes.

Previous attempts to answer this question have centered on student perceptions on the adoption of new LMS software introduced to students. The work of Hadjerrouits in 2010 followed the design process of educational software, and introduced pedagogical experts into the equation in order to improve the overall teaching potential of the LMS. Much like the work that came after Hadjerrouits by Little-Wiles and Naimi, this new research also relied on student surveys in an attempt to pinpoint what users think about using the software. The closest research has come to answering the proposed problem is the work of Stantchev, Colomo-Palacios, Soto-

Acosta, & Misra in 2014, whose research showed that students preferred to use Dropbox as a collaboration tool over the LMS the school provided.

This study attempts to further this research and examine the *why* behind this preference for the online tool over the LMS. For this research study, an attempt to explore the why will revolve around two main research questions:

1. Does a student's use of web applications outside of school affect their ability to use the features of learning management systems in school?
2. Does the frequency of web application use outside of school affect the student's successful adoption of the school's learning management systems?

In an attempt to answer these questions, this study will track user errors in the hopes of discovering how usability of modern websites affects the students' ability to use the features of educational software that is slower to modernize. Ultimately, the goal is to offer best practices on how the user interfaces of learning management systems could be revised so that they more align with what a modern student expects.

Participants

The participants in this study will consist of high school students in Prince William County. Since the county is undergoing a change in learning management systems, from SchoolFusion to Edline, the technology officer will conduct new training for all students on how to use the new software. Only students that have undergone this training will be eligible for the study, as those students have a greater chance of success when adopting the new system.

The study, to begin with, will be limited to one volunteer teacher in the school that utilized the outgoing learning management system effectively. This decision will be made using volunteer teachers, but also by looking at old courses and determining which volunteer has a

good spread of functionality across the features of the old LMS. This decision to limit the student sample size to one teacher (approximately n = 120) should reduce the number of variables because of the fragmented way new technology rollouts occur in school divisions. This will ensure that if students experience success, or failure, they are doing so with the same materials.

Using only one teacher allows the study to localize the study and examine the results of the students equally in terms of the LMS features utilized. The sample is selected out of convenience, but also for validity reasons as well, because random samplings or volunteer samplings may not yield those students uncomfortable with technology, which is deemed necessary for the purpose of the study.

Literature Review

The existing empirical research available surrounding the use of learning management systems (LMS) offers insight into the successful adoption of LMS in schools across the world. The studies typically take two very different approaches, one style focusing on qualitative data in the form of questionnaires given to students and professors, and the other extracting quantitative data by parsing server logs of student's LMS sessions. Most of the research also focuses on university-aged students across the world, and many offer best practices when it comes to adoption and content creation, but not the design of the LMS itself. Despite this difference in research focus from the proposed study, the studies reviewed offer valuable models for designing instruments and testing user experience.

The research conducted by Hadjerrouits (2010) focused on improving the software design process for those creating educational software. The hypothesis was tested that if those experts with pedagogical knowledge were introduced into the cyclical process of software design in the prototyping phases, a better and more robust product could be created for use in the educational

world. The participants of this study were the software developers, three teachers, and 64 students ranging in age from eighth to tenth grade. The students of the three classes reported a positive experience with the co-developed learning system, but many students were not shy in reporting their expectation that there could have been more done to increase the level of animations and interactivity when using the web-based system. The teachers, on the other hand, were generally happy with the process and thought what was created for them by the developers served their educational purposes from an educational perspective (p. 129). This study concluded that in order to create more effective educational products, software engineers need to include pedagogical experts in the design process in order to ensure products that are instructionally sound.

The work of Little-Wiles and Naimi (2011) studied through student surveys the struggle of adopting learning management systems across a university. Their study consisted of 3,544 students enrolled in the College of Technology, and students filled out a thirty question survey about their experiences with the Blackboard system. In addition to the survey, students had the ability to respond freely and comment on their struggles. Some reported that the "interfaces makes little sense" and was "hard to navigate," while many reported having difficulties with "pop-up blockers" and downloading important course files or assignments. Finally, others reported a general feeling that the LMS was "annoying" or "cumbersome" to use (p. 153). The major conclusion of this study was that user errors could be reduced and student experiences could be improved if policies could be enacted university-wide that would force professors into some terms of use when it comes to Blackboard on campus. One suggestion was to make a common template that all professors must use to streamline the process of adopting Blackboard usage in another class.

In Stantchev, Colomo-Palacios, Soto-Acosta, & Misra (2014), the researchers were able to study the perceived usefulness of popular cloud-based storage utilities in comparison to the university LMS they were forced to use for their classwork. They followed the usage of 121 Computer Science students as they completed coursework throughout the semester for one of the classes in their major. One of the interesting findings is that while the adoption of both systems was high, possibly because one was mandated by the course, the levels of expertise reported in both systems were statistically different. As the research study states, "[a]s a result, statistically significant differences between LMS (Mean = 2.62) and Dropbox (Mean = 3.67) were obtained for users' expertise" (p. 615). Potentially because of this result in the mean expertise score, Dropbox scored much higher in several key categories such as ease of use, perceived value, and overall attitude toward using the product. These important categories are some of the determining factors the research study found between students adopting and using regularly a piece of technology to support their studies, and only minimally using technology as a seen as a requirement for class participation. Frustration arises when students have to make a decision between what the right tool for the job is, and their achievement in the course because of their lack of LMS use. One recommendation that the study made is to incorporate these popular third party utilities into the normal operation of courses so that students can use what suits their needs best.

The previous three studies mentioned relied heavily on qualitative questionnaires to inform the research findings regarding the adoption of LMS. Two research studies used the more objective process of parsing server logs in order to gather quantifiable and objective data about LMS usage on university campuses. In 2005, Nickles wrote a script that would parse the usage logs written automatically by LMS for every user session. Since this was an older study, perhaps

the LMS was not a vital part of the educational process where the study was done, because the research yielded no statistical significance between LMS usage and performance in the classroom (p. 122). Furthering this work, Marques and Belo in 2011 used Markov chains in order to try and predict the typical session of a user within an LMS framework. These Markov chains, essentially a prediction tool, tried to pinpoint where users would go next, what features they would use in frequent sequences, all based on their current location (p. 65). This study showed that the average user spent about ten minutes using an LMS in one session, and that most of their clicks revolved around submitting assignments and viewing grades.

No matter the method, these research studies provide only a cursory overview of the proposed research topic. While they may survey users in order to understand their perceptions of the LMS, or examine server logs to objectively report usage statistics, no study previously attempts to offer best practices regarding the user interface of these systems and how they could be improved to offer a more intuitive design that gets more use in school districts.

Instruments

In order to address whether the participants are active users of non-educational online websites that may interfere with or support their ability to use their school's LMS effectively, the students will be surveyed in order to establish their familiarity level with popular trend-setting user interfaces.

Student Survey					
Technology Use Habits	**Yes**			**No**	
Do you use online technologies?					
Categories	Cloud Storage Utilities			Social Media Networks	
Which do you use?					
Hours Per Week	**0-10**			**11+**	
If yes, how many hours per week do you use these online tools?					
Usefulness	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
The websites you reported using are useful in your life…					
Ease of use	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
The websites you reported using are easy to use…					

Once this data has been collected, and the researchers know whether or not they have experience with popular user interfaces, they will observe those students as they navigate the school's LMS. As the students complete assignments the teacher has created for them, the researchers will observe the students to see if they encounter UI elements that they do not know how to use. UI elements where the students become confused and do not use correctly will be marked and the researcher will record the nature of the student's error. This survey also collects

data aligned (perceived usefulness and ease of use) that is with the Technology Acceptance Model (TAM) which was theorized by Davis in 1989 and still stands as a credible model for studying user adoption of software systems. The TAM theorizes that users' acceptance of technology is based on their perception of the usefulness of the product, and the perception of how easy it is to use, and so this TAM-related data will be used in conjunction with the post-observation survey so that researchers may find correlative trends between user-interface difficulties and perceived ease of use. An important part of this collection process will be to make a researcher available while they are filling out the pre-observation survey, so that the students can have any questions that might confuse them answered by a person connected with the study. For the most part, students should know what websites and tools they use on a regular basis, but interpreting the Likert scale for the TAM might be slightly more confusing, so having a researcher on hand will hopefully eliminate any statistical outliers that would be created by students not understanding how to answer the questions associated with the acceptance model.

Researcher Observation		
Observed User Errors	**Yes (if yes, tally how many errors)**	**No**
Did the user encounter a UI element that they did not know how to use?		
Type of Error	**Comments**	
Unable to use collaboration tools		
Unable to find course content to complete assignments		
Unable to submit work correctly to be graded		
Unable to navigate to relevant features		
Unable to find feedback and grades		
Unable to communicate with teacher		
Other? Explain:		

After the student has finished the lesson utilizing the new LMS, the students will then be surveyed again using the constructs of the TAM. As an exit survey, this will be important to establish whether or not students have a positive perception of the LMS in an attempt to predict whether they may adopt regular use of the LMS in the future, but also to extract important information about best practices when it comes to developing software for students with potentially high expectations for the user interfaces they use.

Follow-up Student Survey					
LMS Usefulness	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
The learning software you used to complete the assignments today would be useful to you as a student…					
LMS Ease of use	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
The learning software you used to complete the assignments today was easy to use…					

From these instruments, the researcher will be able to establish a link between whether or not those students that use popular website user interfaces frequently in their personal lives will be helped or hindered when it comes to using the school's LMS. If user errors are encountered, and the perceived usefulness and ease of use levels are also low, then researchers will document those user errors to try and pinpoint if there are any particularly confusing features that perhaps could be redesigned.

Data Analysis

The research study will use descriptive statistics in order to categorize the sample before collecting any inferential data. For the purposes of this study, it is the descriptive statistics that will inform the data collection and support the research study's claims.

In order to prove that the use of online technologies impacts the students' ability to use LMSs effectively, two basic groups need to be formed out of the sample to make analysis easier. From the student questionnaire, the researcher will group students according to their usage of online technologies, which in this case, will only vary between use and non-use. Again, in order to prove that using technology hinders their ability to function within a school's LMS, this basic division among the sample needs to be established. In the group of students that use online technologies, sub-groups will be created according to their frequency of use (0-10 hours, and 11+ hours). This second division will be made in order to see if frequency of use has any correlation on improper LMS usage because of ingrained beliefs about how user interfaces operate, or should operate.

The researcher will then observe students using the LMS and perform all of the necessary functions in order to complete the assignment given by the cooperating teacher. During this observation, a simple tally of user errors will be created in order to keep track of the number of times the student ran into a problem with how to use the interface. The number of total user errors will then be totaled across the groups, and a mean number of errors will be generated for each. This mean number for each group will then be compared in a t-test in order to determine the statistical significance (if any) among the groups, and to analyze the correlation (if any) of home technology use and user errors in LMS usage.

Once the t-tests for the total number of user errors are complete, the results of the TAM-inspired survey questions will be analyzed. Each group will be measured again with the idea of isolating statistically interesting trends between the mean number of user interface errors and the students' perceptions of using the software. Davis' theory suggests that if students make many errors while using a software system, their perception of it will also be negative, so adoption and overall usage will decline as well. This trend analysis will then inform the discussion of best practices at the end of the research study.

Validity and Reliability

In terms of the instruments created by this research study, the validity of the TAM is a long-established construct for testing the adoption of software by gathering data on users' perceptions of usefulness and ease of use. Since these aspects of user adoption have been peer-reviewed and proven to show correlation between user adoption and the construct of the TAM, it is a valid core of this research study to use as the basis for determining whether students incorrectly use features of the LMS. The logic behind using the TAM constructs for this research is that if students do not think the LMS is easy to use, or worse, they do not see it as useful enough to invest the time in understand, then these data points can be the driving force for discussion of best practices and redesign efforts. In addition using an already established model, a researcher will be posted at every survey session in order to ensure validity of the results by answering any questions the students may have about the Likert scale. The Likert scale questions may be difficult for students to grasp in terms of how to strongly disagree with something inanimate, but researchers will soothe any misunderstandings by rephrasing the polling questions if necessary.

The non-TAM questions on the pre-observation survey are simplified and broad enough that students should be able to report their technology use accurately. The frequency of use categories were created based on the number of hours that someone would have to use an online service to be considered a frequent user, with the upper end of this spectrum (11+) being set at approximately 90 minutes per day. While there is no research to back up this method for grouping users in this manner, it was picked more out of convenience to the students for them to report the data more accurately by easily adding up the total number hours they believe to use those services.

The validity of the results produced by the researcher observation of students using the LMS system relies on the premise that in this stage of the research study, the research is limited to observation of one teacher's lesson plan utilizing the technology. As was found in the literature review, previous studies conducted found that at the university level there was no consistent implementation of the LMS across the school, so it would be difficult to consolidate results across many different teachers if not all teachers utilize the LMS in the same way. Looking at the user errors generated by one teacher and one lesson will allow the study to produce more meaningful results to be compared later.

The other important detail where validity is concerned is that the instrument for the researcher observation will include the different types of errors that are typical in LMS features. This is done with the idea that researcher bias could sway the observation and could make the researcher interpret something as a user error that was really not. With the instrument specifying the types of errors that users can make, it does not allow for any projections to be made by the researcher on the data.

The data generated by this study, overall, should also represent a typical high school population, since the only requirement is that the students be trained by the county. The LMS is not determined to be hard software to use, and since the LMS rollout is for freshmen through seniors, the training requirement should provide a reliable slice of the student population, no matter the grade level. Once a participating teacher is selected, the grade level will be determined based on his/her schedule for that year, and the study will only start after all classes have been to the county training.

Limitations

One of the major limitations of the research study is also one of its strengths. In the observation instrument, specific user errors are listed for the research observer to check off as they are made over the course of the lesson. While this is a strength that removes user bias, it also does not take into account *all* UI errors that could occur in such a complex and feature-rich environment of the modern LMS. In order to keep the observation instrument streamlined and make it less cumbersome to use during the observation, it requires some trimming of the reporting options. If the study were to enter a second phase with more teachers and students, the observation instrument should eventually be revised based on the observers' experiences and take into account UI errors that may not have been included in the initial study.

One limitation, as is the limitation with many research proposals, is the sample size of the initial study. In this study, the sample size is deemed adequate enough to look for correlations between the personal and educational software, but if the study were to enter into a second phase, this limitation could be removed by adding more teachers (hopefully using the same features) and more students. In that same vein, the grade level of the participants could produce statistically different results, not because older students would be familiar with the software (it is

new for everyone), but because older students would be able to better handle the extra cognitive load of using a new LMS and completing the assignment. For younger students, this could be too much to learn or complete all at once, and may hinder their ability to effectively use the LMS, complete the assignment, or both.

The current study as it stands collects data inspired by Davis' Technology Acceptance Model (TAM). While the TAM is a long-established model to test technology adoption, this project is using the same numbers with a different spin – to infer best practices based on student's preferred technology and their perception of the LMS. This could be seen as perhaps too big of an inference to make between the data that the TAM generates and the conclusions that could be drawn about best practices at the end of the study.

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