

A Student-Centered Analysis of the Design of Virtual Learning Tools

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Virtual learning has transformed modern education for students and instructors alike, enabling a fully remote classroom experience without having to leave home. Virtual learning environments are softwares, often websites, that allow teachers to deliver course content to their students remotely and facilitate student to teacher and student to student interactions. While virtual learning platforms have been in use for years, the COVID-19 pandemic has accelerated their adoption by forcing schools to adapt to a distance learning environment. The circumstances of the pandemic have given virtual learning platforms the perfect environment to thrive in by making in-person instruction a luxury. The US Census Household Pulse reported that over 74% of households with children had to take part in some form of distance learning due to the pandemic (McElrath, 2021). While COVID-19 accelerated the pace at which educational institutions adopted new virtual learning environments, this fundamental change of education was inevitable considering the rise of technological accessibility and literacy. Many classrooms, even after returning to in person instruction, have adopted the convenient aspects of online learning including lecture recordings, online office hours, and online message boards to create a hybrid, or blended, environment.

Unfortunately, spending more time online has also increased amounts of academic stress and anxiety for students all over. Many learning institutions have taken reactive approaches to this problem, prescribing solutions after the problems have already arisen. A proactive approach, on the other hand, would allow institutions to identify triggers in the environment and mitigate them before they cause harm (Lister, Seale, and Douce, 2021). This proactive approach is both the responsibility of educational institutions and those that design these virtual learning platforms. To help support proactivity, it is crucial to examine the mutually shaping relationship

between student wellbeing and virtual learning environments. What changes do virtual learning platforms make in the lives of students, and in turn, how should these changes influence the design of these platforms? An examination of this relationship with regard to accessibility, memory, and motivation helps us understand the importance of strategic user experience design in a student-centered virtual learning environment.

Background

In order to understand the impacts of virtual learning, it is first necessary to understand the factors that have contributed to its emergence. Educational organizations, which include Educational Management Organizations, school boards, university accreditors, and various other groups, play a significant part in the growing role of technology in education. Educational organizations are responsible for curriculum design, and have also begun to require technological literacy of their faculty for both administrative and content delivery purposes. For instance, Fairfax County Public Schools explicitly require their instructional personnel to be able to effectively use computer software in a professional setting, and integrate with the Virginia Standards of Learning to present the curriculum. These types of requirements are becoming more and more common for instructors and play a large role in the adoption of software tools in the classroom (*National Center for Education Statistics, 2002*). Though some could argue that FCPS is one of the most well-funded school districts in the country and thus has higher technological literacy, the digital revolution has made smart technology more accessible to everyone, giving over 77% of Americans some form of access to the internet. As this number steeply increases, the impact of the digital divide will narrow and the adoption of virtual learning technology will become more universal (Ryan & Lewis, 2017).

Educational organizations also have the power to decide what educational platforms will be used by the majority of the organization, therefore playing a significant role in the academic workflow of students and instructors. It is important to note each educational organization serves a different set of needs, and thus will adopt tools that serve those needs. For example, a school board for an elementary school may search for tools and platforms like ClassDojo that target younger children through the gamification of learning, while a K-12 school board may opt for tools that cast a wider net and target students of all ages. These differing objectives have warranted the creation of many different learning platforms, some of the more popular ones being Moodle, Canvas, and Blackboard. Rather than figure out the best way to tailor tools for specific groups, this paper examines design techniques that can be applied to tools with more general audiences in mind.

Methods

This paper will investigate the relationship between virtual learning platforms and student learning outcomes, and how to effectively design virtual learning platforms to account for this relationship. I will continue by specifically discussing the areas of accessibility, memory, and motivation as they relate to virtual learning platforms and examining the aspects of user experience design that are connected to these areas. For each section, using a series of literature reviews, I will explore both directions of the mutually shaping relationship between that facet and virtual learning tools. After reviewing these three areas, the discussion section will deduce what elements of user experience design can help distinguish a well-designed virtual learning tool by analyzing the patterns in the evidence from the literature reviews. By examining the relevant literature, we hope to discover the characteristics of a good virtual learning environment.

Impacts of Virtual Learning Environment Design

I. Accessibility

Accessibility is a crucial consideration in the assessment of virtual learning tools, especially because those with disabilities are technically a minority in a learning environment. Students come from various diverse backgrounds and abilities and thus have very different requirements of a virtual learning tool. Unfortunately, only 24% of faculty actively alter their teaching approach to accommodate students with disabilities, which is especially disappointing considering that disabled and neurodiverse students comprise almost 14% of public-school enrollment (National Center for Education Statistics, 2021). To make matters worse, according to the National Center of Education Statistics, the majority of faculty are not prepared to make accommodations for the students that ask for them (Phillips et. al., 2012). The onset of the pandemic has only aggravated the unpreparedness of these instructors because many did not have time to appropriately adjust their teaching approaches. Considering the general inability and unwillingness of instructors to make accommodations for their students, virtual learning environments offer an opportunity to bridge the accessibility gap between students with and without disabilities.

The case of e-learning and the visually impaired demonstrates that current technology has not yet successfully bridged this gap. As of 2015, Blackboard was the only Gold certified tool for accessibility by the National Federation for the Blind, illustrating the lack of suitable tools for students with disabilities (Zhang et. al., 2021). A group of researchers at Dawson College studied a group of disabled students to assess the accessibility of virtual learning tools and found that online content like Flash, videoconferencing, and Powerpoints were poorly accessible to those that are visually impaired, partially due to the low flexibility of online interfaces and temporal

tools for professors. For example, if a student needed additional time on an assignment due to complications related to a disability but an instructor was unable to configure a different deadline on the submission platform, they would be at a disadvantage due to a poorly designed tool. This demonstrates the importance of configurability in an online learning tool, including features that allow instructors to alter their approaches for different students. These features can include the inclusion of alternative forms of content presentation for instructors, such as closed captioning on video tapes, fonts that allow for spoken content, and other enhancements to otherwise analogue content (Kent, 2015).

Though they often put those with physical disabilities at a disadvantage, virtual learning environments are inherently beneficial for students with some forms of neurodiversity. According to the 2015 edition of *Disabled Studies Quarterly*, online education allows for heightened social interactions for students who struggle with face to face interactions and in-person environments (Kent, 2015). Online learning environments enable students to tailor their educational experience to their own learning styles, which can be helpful for students with disabilities. Though the concept of “learning styles” has been widely accepted as a myth in scholarly communities, students still learn differently from one another and tend to benefit from variety in the way content is presented (Yale University, n.d.). The ability to present content using various different mediums is an important characteristic of any content delivery tool, especially for neurodiverse students who differ from others in terms of reading comprehension, ability to focus, and various other factors.

In response to the call for more diverse content presentation methods, developers have integrated multimedia options into their tools. Multimedia, or the inclusion of various different mediums of presentation, has long been known as a great tool for diversifying content delivery in

a virtual learning environment. The use of different mediums in a lesson, such as audio and video, allows students to choose which strategies are most engaging for them. Multimedia can also help to further engage the viewers in the content, which makes the information more likely to be stored in long term memory (Faghieh et. al., 2014).

In addition to multimedia, virtual learning tools have integrated learner control techniques to help students have control over their pace and order of content review, which allows students to tailor their learning experiences to their own preferences (Faghieh et. al., 2014). Learner control strategies are “instructional strategies through which learners can exercise some level of control over the events of instruction. It means that learners make their own decisions regarding the sequence, pace, flow, amount, and review of instruction,” (Simsek, 2012). This inherently allows students who may need accommodations to make their own decisions about the pace of their learning. Learner control strategies fall into two main categories. The first allows for free perusal of course content so students are in more control of their learning pace. The second includes strategies such as placing time constraints on sections of course content, which can be helpful to neurodiverse students that may struggle with pacing (Terras & Ramsay, 2014). While these two classes of learner control techniques seem contradictory to each other, both fall under the umbrella of temporal control, or the idea of having some control over the time and order in which a student progresses through content.

II. Memory

Understanding memory in the context of online learning is crucial to designing good virtual learning tools. A large part of this is understanding the temporal nature of online content delivery; when students interact with their online courses, the experience of time plays a significant role in whether the information is retained or not. A literature review in the Journal of

E-Learning and Digital Media found that in order to truly learn content, students must also remember how they learned that content, which includes *when* they learned it, *how long* it took them, and various other temporal factors. (Terras & Ramsay, 2014). Physical state is also significant when considering e-learning from a temporal viewpoint. When focusing for a long period of time, the brain tends to get tired and the ability to retain new information is reduced. These mental changes that occur while learning information are also known as “flow”. Flow can be accounted for with learner control techniques such as offering timed lessons or adding features that allow instructors to restrict movement in a lesson based on time, or any other tools that enable the instructor to have more control over the process by which students’ complete lessons or modules (Terras & Ramsay, 2014).

When discussing information retrieval, we also must consider the concept of context in learning environments. Students tend to better retrieve information when the environment (in this case, the layout, presentation, colors, etc. of the user interface) is similar to that where they learned it. There are two options for handling this, the first being enforcing similar user interface designs for both lessons and the methods of assessment. This approach can be problematic in that it further trains students to only recall that information in one particular setting. The second option is providing diverse options for presenting information in lessons. Course designers typically lean towards the second option because it allows students to generalize learned information to more settings and contexts (Terras & Ramsey, 2014).

III. Motivation

Many studies have shown that students that have intrinsic motivation regarding a course or subject have higher levels of academic achievement, lower anxiety levels, and more confidence with the subject (Saeed & Zyngier, 2012). According to a paper in the Journal of

Child Development Perspectives, the newfound autonomy that students have in how and when they cover course material boosts student motivation and understanding of the content (Wigfield et. al., 2016). On the other hand, some claim that the newly attained freedom that comes with online learning is detrimental, as students tend to become distracted and unable to engage with the content. According to Eric Anderman, an education psychology professor at Ohio State University, the increased faculty supervision that comes with in person learning often helps students build a sense of accountability that is crucial in engaging them in the content and keeping them motivated (Stringer, 2020).

Fomenting motivation via e-learning can be described with the ARCS model (first documented in 2004 in the Journal of Educational Media), which emphasizes four aspects: attention, relevance, confidence, and satisfaction. The first aspect of the ARCS model highlights the use of diverse media throughout a lesson to continuously renew a learner's attention to the content. Relevance entails the perception that the course content is consistent with the learner's goals. While this is mostly dependent on course content and not user experience design, creating goals with checklists and progress bars can help to manufacture goals by giving learners something to work towards, therefore increasing content engagement and relevance. This is also tied in with the confidence aspect of the ARCS model, which states establishing positive relationships and expectations for their success is key in growing learner confidence. These three conditions help establish motivation, but satisfaction helps students feel positive about their user experience. This can also be achieved by creating intermittent goals and steps for students in a course (Keller & Suzuki, 2004). While ARCS seems outdated for a model that describes a constantly evolving technology, it provides a good summary of what areas are relevant to student motivation and what can be done to cater to those areas.

Discussion

From this analysis, it is evident that existing research suggests a wide array of strategies for virtual learning tool design. Across the areas of accessibility, memory, and motivation, the most common user experience recommendations can be compiled into a few primary characteristics of a well-designed virtual learning environment: configurability, diverse presentation options, and temporal control.

While the ultimate success of a course depends on the instructor, the configurability of a virtual learning platform can truly enhance or hinder the learning experience. Configurability in terms of virtual learning platforms most often describes the instructor's ability to uniquely customize aspects of a course. With regard to accessibility, the presence of customizable options in a virtual learning tool can allow instructors to accommodate specific student needs. Virtual learning platforms should enable a wide range of functionalities, such as the ability to edit exam times, in order to provide different accommodations to different students. Additional configurable functionalities include the ability to incorporate multimedia or set time restraints on different sections of the content. Configurability should always be paired with an intuitive user interface – the ability to configure things is valuable, but its value is dampened if the interface is clunky and difficult to navigate.

Diverse presentation methods were the most consistently endorsed suggestion across the analyzed literature. This is often done through multimedia, which entails content diversification via videos, audio, and various other forms of content presentation. Variation in the methods of presentation helps cater to students that learn differently from others, which often includes neurodiverse students. Alternative forms of content presentation like closed captioning and text-to-audio are also crucial to increasing accessibility to those with physical disabilities. Multimedia

can also help maintain learner attention throughout the learning process, which is a critical aspect of student engagement with the content. This in turn helps build stronger connections with the content, which can contribute to a learner's sense of motivation and information retention. Incorporating multimedia into a virtual learning environment may include the integration of video, audio, music, and animations as options for content presentation. However, it is important to ensure that these additions do not hinder the physical accessibility of a tool – for example, make sure that audio and video are functional on various different devices so that differently abled students are not at a disadvantage.

Temporal control describes the ability of instructors to regulate how their students experience their course content in terms of time. Various pieces of literature reference learner control techniques as a method to ensure that students spend an appropriate amount of time engaging with the content, and that the content is viewed in the correct order. Courses that implement learner control techniques can be beneficial for neurodiverse students that may need help to focus and regulate the pace of their learning. Learner control techniques can also address “flow,” which is the idea that the information a student remembers is dependent on their temporal workflow. In order to properly integrate these techniques into a virtual learning platform, a virtual learning platform may allow instructors to specify time constraints on different portions of a lesson. An instructor may also decide that certain portions should be flexibly paced by the student to boost self-efficacy and motivation. A well-designed virtual learning platform should allow instructors to determine whether time constraints or flexibility may be best strategy for the content they are presenting.

Conclusion

The onset of the COVID-19 pandemic has dramatically accelerated the transition of education into a more virtual experience. Even as most schools transition back to in person learning, blended courses are becoming increasingly popular. This rapid transition has warranted a proactive approach to ensuring that students are not negatively impacted by virtual learning environments, which can be done by analyzing the mutually shaping relationship between students and virtual learning platforms.

From research in the areas of accessibility, memory, and motivation, it becomes evident that instructors of courses play an incredibly significant role in the success and effectiveness of a course. They ultimately determine the pace of the course, what techniques to use, and how to present their content. However, if a virtual learning environment doesn't provide them with many options, both the instructor and students are at a disadvantage.

Commonly recommended design strategies for virtual learning tools include multimedia options for content presentation and temporal control options that allow instructors to control student workflows. The inclusion of multimedia in a course helps to facilitate the generalization of content across more contexts and maintain student attention throughout a lesson. Diverse presentation methods are especially helpful to neurodiverse students and students with disabilities who often differ in their learning approaches. Temporal control techniques are also valuable to helping neurodiverse students pace themselves in a course, especially if they struggle with the self-regulation of their learning. Considerations of time in tool design also help to boost information retention and student motivation.

Together, this research communicates the importance of configurability, diverse media options, and temporal control techniques in the design of student-centered virtual learning

platforms. The future of virtual learning would undoubtedly benefit from more specific research into how these aspects of a learning tool influence student performance and learning outcomes. Ultimately, taking a proactive approach to understanding how students are impacted by virtual learning environments can lead to a better classroom experience for students and instructors alike.

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