

**Satori: Developing A New Course Management System**

**Education Technology: Considering the Impacts of Online Learning in the Development of  
New Academic Tools**

A Thesis Prospectus

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By

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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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Especially with the onset of the pandemic and the subsequent move to online education, educational technology has transformed the modern educational experience — the circumstances of the pandemic have given educational technology the perfect environment to thrive by making in-person instruction a luxury. US Census Household Pulse Survey data shows that over 74% of households with children in school took part in some online form of distance learning due to the pandemic (McElrath, 2021). While COVID accelerated the pace at which educational institutions adopted new tools, this fundamental change of education has been approaching for years with the increasing accessibility of technology, and increasing technological literacy amongst all generations.

Though the steep increase in online education in the last two years was warranted by the pandemic, as students and faculty discover more advantages of online content delivery, educational technology continues to spread even as the pandemic comes closer to an end. Many classrooms, even after returning to in person instruction, have adopted many of the convenient aspects of online learning including lecture recordings, online office hours, and online message boards to create a hybrid environment for students and faculty.

In addition to the pandemic, educational organizations also play a significant part in the growing role of technology in education. These organizations (which include Educational Management Organizations, school boards, university accreditors, etc.) are responsible for curriculum design, which play a large role in course formats. Educational organizations have also begun to require faculty to use technology to a certain extent in their classrooms, 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 these technologies 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).

As the role of educational technology becomes increasingly prevalent, it is important to understand the long term impacts of these tools. The transition to online learning has also emphasized the necessity for well designed course management tools. The STS topic portion of this prospectus will delve further into how educational technology impacts students, and how to use that information to design effective software. The technical topic portion will detail the development of Satori, an open-source course management system being developed for the Program and Data Representation course taught at the University of Virginia.

### **Technical Topic**

The technical portion details the continued development of Satori, an open-source application that will be used as the primary course management system for CS 2150 (Program and Data Representation). The current system consists of two primary course tools: a support request management system and an office hours queue. While the system was functional in the initial years the course was offered, as it has grown in the last decade, the course tools no longer serve their purpose. CS 2150 is currently a required course for all computer science majors and minors, making its enrollment approximately 500 students per semester. These large enrollment sizes have overwhelmed the old system, causing long response times, data consistency glitches, and frequent freezes that render it unusable for long periods of time. These are typically described as scalability problems, which are described as problems that do not offer rational performance rates as user bases grow (Rana, et.al., 2019). These problems make it difficult for

students to get help on assignments and for teaching assistants to manage office hours. The site is also restricted by a very primitive user interface.

In order to address these issues, under Professor Aaron Bloomfield, the development team is creating a web-based application that will facilitate office hours and ease the handling of support requests. It was initially designed with the goal of handling all aspects of the course, including support requests, office hours, assignments, exams, and grades. However, shortly after development began, the course adopted Gradescope for assignment submission, and the new system no longer needed to implement a separate system for assignments and grading. This made it so that the system had a lot of unnecessary built in complexity, making the codebase very difficult to work with. This caused a multitude of issues, including problems with adding courses and creating queues. With this new set of issues, the team decided to restart development from scratch to remove some of this complexity from the system and make the system more scalable.

Another consideration is changing course requirements in the Department of Computer Science. It was recently announced that the department is introducing a new curriculum for all new students, which means that CS 2150 will no longer be offered after the Fall 2022 semester. As such, though the development will be done with the particular use case of CS 2150 in mind, the ultimate goal is for this tool to easily adapt to handle additional courses in the future.

The front end of the Satori project is built using Django, which is a Python based web development framework, and the back end consists of a MySQL database. MySQL is known for being a robust database engine that preserves data integrity, which is crucial to avoid the data inconsistency issues that were faced in the old tool. In terms of scalability, MySQL is high performing, especially when limited to the scope of just UVA computer science courses (Branson, 2016). Ultimately, the tool will be deployed in a Docker container to facilitate the

linking of the login system with NetBadge, which is UVAs centralized login tool. The design for the project breaks it up into 3 primary apps: core, queue, and tickets. The core app mostly consists of high level management of courses such as creating courses, adding students and teaching assistants, and provisioning permissions. The queue app will allow professors to create queues for courses they teach. Students should be able to add and remove themselves from queues for courses they are enrolled in, and teaching assistants should be able to remove students from the queue so they can help them. Finally, the tickets app will function as a central location where students can contact the professor for assistance, and view all relevant communication surrounding their support tickets.

The development team is approaching the project with an agile methodology, in which there are multiple small “sprints” where certain features are completed. Each feature of Satori will have extensive unit tests and each app will undergo usability testing upon completion using the current CS 2150 TAs as the representative users. From this feedback, the tool will be further refined. Ultimately, the development team hopes to create a tool that will be appealing and easy to navigate for students and instructors alike.

### **STS Topic**

The specific details of a piece of online learning technology can have a significant impact on accessibility and the mental health of students, thus demonstrating a compelling interface between technology and society. This information can and should be leveraged by companies that produce educational technology to set themselves apart and foster a better learning experience for the students and instructors that use their tools.

#### **I. Accessibility**

It's difficult to fully assess the impacts of online learning without considering accessibility. It is incredibly important to take account of the diverse backgrounds of students and note that every student has different requirements for their educational tools. This notion is especially important when considering that disabled and neurodiverse students comprise almost 14% of public school enrollment, according to the National Center for Education Statistics (2021). Access to online education inherently is helpful to many students who identify as disabled. According to the 2015 edition of *Disabled Studies Quarterly*, online education allows for heightened social interactions for disabled students who struggle with face to face interactions, and for students who generally struggle in in-person environments (Kent, 2015).

Another key aspect is the ability of students to tailor their own educational experiences to their learning styles, which can be very helpful for students with disabilities. The use of multimedia is a common tactic that e-learning tools use to allow instructors to diversify their content; students may have different learning techniques, and the presentation of various different media can allow students to maximize their information retention. Multimedia also helps to engage the viewers in the content, which makes the information more likely to be stored in long term memory. Music is a particularly powerful form of multimedia — in the right setting, specific types of music can be a motivator that reduces stress and increases concentration and performance; however, there is also a significant cognitive cost of listening to music, and it therefore should not be played when the student is in high stress situations such as an exam. Giving instructor audio options for music on other pages may be beneficial for student knowledge retention. In addition to multimedia, learner control techniques can help students have control over their pace and order of content review, which allows students to tailor their learning experiences to their own preferences (Faghih, et. al., 2014).

The design of these educational technology tools becomes increasingly important when examining how instructors use them. According to a study by the Journal of Postsecondary Education and Disability, only 24% of faculty actively alter their approach to teaching to accommodate students with disabilities, and 54% of faculty feel unprepared to make appropriate accommodations for students who do ask (Phillips, et. al., 2012). The onset of COVID has exaggerated these statistics because many instructors did not have much time to adjust their teaching approaches with the sudden switch to online instruction. When professors often do not make conscious efforts to make their material accessible to all students, technological tools play an important role in bridging the gap between students and instructors. Current technology, however, has not successfully bridged this gap; as of 2015, Blackboard was the only Gold certified tool for accessibility by the National Federation for the Blind (Zhang, et. al., 2021). Some potential tools to make material accessible are closed captioning on video tapes, fonts that allow for spoken content, and other enhancements to otherwise analogue content (Kent, 2015).

## **II. Psychological Impacts**

Online learning has transformed education, and in doing so, it also transformed the psychology of students. According to a 2016 paper published 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). Because of the increased flexibility in student schedules, students have been able to tailor their learning to their individual learning styles. As aforementioned, multimedia is often used as a tool by e-learning platforms to help better tailor instruction to different learning styles, which in turn increases intrinsic motivation to learn (Faghih, et. al., 2014).

On the other hand, some claim that the newly attained flexibility of online learning is not a positive, 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 competency that is crucial in engaging them in the content and keeping them motivated and engaged (Stringer, 2020). According to Behnam Faghih, et. al., integrating tools for informal communication such as discussion boards can help build relationships between students and faculty which in turn increases student accountability. The paper also recommends multimedia, strategic placement of content, and animations (such as Clippy from Microsoft Word) to increase student engagement. In addition, to allow the brain to process information more easily, it is always a good idea to remove unnecessary clutter that distracts the student from the content at hand, and highlight the key information to move to long-term memory (2014). It is also shown that interfaces that allow for creativity and flexible use have a significant positive impact on engagement and retention (Hsu and Ching, 2013).

### **Research Question and Methods**

My STS research question is: How do e-learning tools impact students, and how can knowledge of these impacts help in the design of educational technology?

Because of the nature of this socio-technical problem, it will be crucial to conduct a thorough analysis of the causal relationships between society and educational technology. In the assessment of the impacts of educational technology, emergence will be a particularly helpful framework to leverage. Particularly, this topic focuses on what the unintended emergent behaviors of the adoption of educational technology may be (for instance, decreasing attention span in young adults). This provides a good lens to interpret how educational technology



changes society, which may provide more insight into how to optimize the effects. To analyze the opposite relationship, social shaping may also be a useful framework to utilize. Social shaping is a framework that theorizes that technology is consistently shaped by dominant values in society. It goes one step further to claim that technology is a social product (Russell and Williams, 2002). In the context of this problem, societal norms and human response should be leveraged to shape educational technology to maximize the benefit. Together, these two frameworks help capture the mutualistic relationship between the two entities. Essentially, the goal is to successfully capture the push and pull relationship between individuals in society and how technology is designed. For further research, it will be interesting to integrate testimonies from developers of educational technology to gain insight into the workflow for designing these e-learning tools (what considerations are currently being made, how purposeful are the developers, etc.).

### **Conclusions**

Online learning has dramatically transformed the lifestyles of students across the globe. The STS topic details some of these transformations, and how they should influence the development of educational softwares. The two primary areas of focus are accessibility and psychologically emergent properties in students, both of which are largely addressed by fundamental changes in how the user interface of e-learning tools are designed. The technical topic follows the development of Satori, a course management web application for Program and Data Representation at UVA (CS 2150). The new tool will replace the old tool, which is outdated and not scalable. Insight from the STS topic can easily be applied by the development team in order to ensure the application is consistent and user friendly. In the further exploration of these topics, it would be incredibly helpful to contact subject matter experts and gain a fundamental understanding of how educational technology is developed.

## References

- Abramson, A. (2021, September). Capturing the benefits of remote learning. *Sdl.Web.DataModel.KeywordModelData*, 52(6).  
<http://www.apa.org/monitor/2021/09/cover-remote-learning>.
- Alhumaid, Khadija. (2019). Four Ways Technology Has Negatively Changed Education. *Journal of Educational and Social Research*. 9. 10-20. 10.2478/jesr-2019-0049. Retrieved October 14th from  
[https://www.researchgate.net/publication/336969538\\_Four\\_Ways\\_Technology\\_Has\\_Negatively\\_Changed\\_Education](https://www.researchgate.net/publication/336969538_Four_Ways_Technology_Has_Negatively_Changed_Education).
- Appanna, Subhashni. (2008). A Review of Benefits and Limitations of Online Learning in the Context of the Student, the Instructor and the Tenured Faculty. *International Journal on E-Learning*. 7.
- Branson, T. (2016, November 16). *8 big advantages of using mysql*. Datamation. Retrieved November 1, 2021, from  
<https://www.datamation.com/storage/8-major-advantages-of-using-mysql/>.
- Carstens, K. J., Mallon, J. M., Bataineh, M., & Al-Bataineh, A. (2021). Effects of Technology on Student Learning. *The Turkish Online Journal of Educational Technology*, 20(1). Retrieved October 14th from <https://files.eric.ed.gov/fulltext/EJ1290791.pdf>.
- Faghih, Behnam & Azadefar, Mohammad & Katebi, Seraj. (2014). User Interface Design for E-Learning Software. 10.7321/jscse.v3.n3.119. Retrieved October 14th from  
[https://www.researchgate.net/publication/259893577\\_User\\_Interface\\_Design\\_for\\_E-Learning\\_Software](https://www.researchgate.net/publication/259893577_User_Interface_Design_for_E-Learning_Software).

- Hattangdi, A., & Ghosh, A. (2008). Enhancing the quality and accessibility of higher education through the use of Information and Communication Technologies. Retrieved September 24, 2021, from <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.573.1307&rep=rep1&type=pdf>.
- Hsu, Yu-Chang & Ching, Yu-Hui. (2013). Mobile App Design for Teaching and Learning: Educators' Experiences in an Online Graduate Course. *International Review of Research in Open and Distance Learning*, 14, 117-139. 10.19173/irrodl.v14i4.1542.
- Izadpanah, S., & Alavi, M. (2016). The Perception of EFL High School Students in Using of Computer Technology in the Process of Learning: Merits and Demerits. *Advances in Language and Literary Studies*, 7, 146-156. Retrieved October 14th from <https://files.eric.ed.gov/fulltext/EJ1127249.pdf>.
- Kent, Mike. (2015). Disability and eLearning: Opportunities and Barriers. *Disability Studies Quarterly*, 35, 10.18061/dsq.v35i1.3815. Retrieved September 24, 2021, from <https://dsq-sds.org/article/view/3815/3830>.
- McElrath, K. (2021, October 8). *Nearly 93% of households with school-age children report some form of distance learning during COVID-19*. Census.gov. Retrieved November 1, 2021, from <https://www.census.gov/library/stories/2020/08/schooling-during-the-covid-19-pandemic.html>.
- National Center for Education Statistics. (2002, November 4). *Technology in Schools: Suggestions, Tools, and Guidelines for Assessing Technology in Elementary and*

- Secondary Education*. National Center for Education Statistics (NCES) . Retrieved September 24, 2021, from [https://nces.ed.gov/pubs2003/tech\\_schools/chapter7.asp](https://nces.ed.gov/pubs2003/tech_schools/chapter7.asp).
- National Center of Education Statistics. (2021, May). *Students With Disabilities*. Coe - students with disabilities. Retrieved October 14, 2021, from <https://nces.ed.gov/programs/coe/indicator/cgg>.
- Phillips, Amy & Terras, Katherine & Swinney, Lori & Schneweis, Carol. (2012). Online Disability Accommodations: Faculty Experiences at One Public University. *Journal of Postsecondary Education and Disability*. 25. Retrieved September 24, 2021, from <https://files.eric.ed.gov/fulltext/EJ1002144.pdf>.
- Rana, Muhammad Ehsan & Farooq, Usman & Wanabrahman, Wan Nurhayati. (2019). Scalability Enhancement for Cloud-based Applications Using Software Oriented Methods. *International Journal of Engineering and Advanced Technology*. 8. 4208-4213. 10.35940/ijeat.F8869.088619.
- Russell, S. & Williams, Robin. (2002). Social shaping of technology: Frameworks, findings and implications for policy. *Shaping technology, guiding policy: Concepts, spaces and tools*. 37-120.
- Stringer, H. (2020, October 13). *Zoom school's mental health toll on kids*. <http://www.apa.org/news/apa/2020/online-learning-mental-health>.
- Tahir, R., & Arif, F. (2015). A MEASUREMENT MODEL BASED ON USABILITY METRICS FOR MOBILE LEARNING USER INTERFACE FOR CHILDREN.
- Wigfield, A., Gladstone, J., & Turci, L. (2016). Beyond Cognition: Reading Motivation and Reading Comprehension. *Child development perspectives*, 10(3), 190–195. <https://doi.org/10.1111/cdep.12184>.

Zhang, Han & Nurius, Paula & Sefidgar, Yasaman & Morris, Margaret & Balasubramanian, Sreenithi & Brown, Jennifer & Dey, Anind K. & Kuehn, Kevin & Riskin, Eve & Xu, Xuhai & Mankoff, Jen. (2021). How Does COVID-19 impact Students with Disabilities/Health Concerns?. Retrieved September 24, 2021, from <https://arxiv.org/pdf/2005.05438.pdf>.