

Undergraduate Thesis Prospectus

Piano Learning Aid

(technical research project in Electrical and Computer Engineering)

The Struggle over Technology in Education

(STS research project)

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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General research problem

How can education technology be improved?

In two decades, classroom technology has developed from carted projectors and televisions to laptops for individual students, multitudes of online collaboration resources, and the beginnings of artificially intelligent instruction. Such developments offer opportunities and hazards. The success of education technology depends on the goals of education. According to Common Core, students who graduate from high school need “the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live” (Common Core, 2019). Others contend that successful education promotes social and emotional development. According to Giancarlo Brotto, “social and emotional learning is critical to a child’s development, as it directly correlates to success and happiness as an adult” (Brotto, 2018). Education technology can be evaluated against these goals.

Piano learning aid

How can a piano be adapted to teach users to play?

This technical capstone project is advised by Professor Harry Powell of the Department of Electrical and Computer Engineering. The collaborating researchers include Ian Greene, Mert Karakas, and Eddie Russell. The goal of the project is to build a system that can be added to any standard piano and that takes sensory input and returns observable feedback to a user. The system must include an embedded component to compute software calculations and manage hardware.

A similar solution to this system already exists built-in to many electronic keyboards. These keyboards use LEDs built into the keys to signal which notes to play and receive input from the user through mechanical switches connected to each key. Our system will use similar ideas to the existing solution but will expand from it by being a separate component from the instrument. By being separate, the system can be attached to be used with an existing piano instead of integrating the functionality into a new electronic piano.

To build a prototype of this system, we will need to use hardware components such as LED strips, microphones, and a microprocessor. These components will be connected through a printed circuit board that supplies power to each component. To create the software for the software for digital signal processing and control, we will use LabView with field programmable gate arrays. For testing data going in and out of the system, we will need waveform function generators and oscilloscopes. The system will be verified as a unit attached to a piano to validate the ability to teach a user a simple song.

The struggle over technology in education

How are instructors, students, educational technology vendors, and administrators competing to shape the policies governing classroom technology use?

Classroom technology has a mixed record. Sana (2012) found that “participants who multitasked on a laptop during a lecture scored lower on a test compared to those who did not multitask.” Because people tend to overestimate their ability to multitask, “students are more commonly found engaged with their laptops or smartphones during

class time.” Even “participants in view of multitasking peers scored significantly lower on the test” than others, due to the distraction of neighbors’ devices.

But technology in the classroom can be beneficial. Sawyer (2017) showed that “integrating multimedia presentation of lesson material with active-learning techniques enhanced educational benefits” relative to spoken or written presentation alone.

Claro et al. (2012) contends that while technology can help students develop Information and Communication Technology (ICT) skills, it can also foster dependence limiting creativity. The researchers found that the technology helped students act as consumers and learn, but appeared to limit their development of producer skills. “Only one third of the students could develop their own ideas in a digital environment and less than one fifth could refine digital information and create a representation in a digital environment” (Claro et al. 2012).

Software companies sell instructional programs to schools by advertising to them their ability to improve efficiency of education. Squirrel AI Learning (2019) implements adaptive learning in machine learning technology, claiming that its “platform provides students with a supervised adaptive learning experience that has been proven to improve both student efficacy and engagement.” Since it was founded in 2014, Squirrel has grown quickly. Squirrel has built an expansive network of classrooms, “opened over 1700 schools and has 3,000 teaching staff in more than 200 cities” in China. It claims that, one of its products, an AI simulated human teacher, provides thousands of students with “a personalized learning plan and one-on-one tutoring, with 5 to 10 times higher efficiency than traditional instructions.”

The International Society of Technology in Education (ISTE) sets standard for education technology. ISTE claims it stands for “the power of technology to transform teaching and learning, accelerate innovation and solve tough problems in education” (ISTE 2019). In September 2019, after 88 percent of North Carolina educators “agreed that the ISTE standards represent the digital skills students need for success today and in the future,” the North Carolina State Board of Education adopted ISTE’s standards. According to an ISTE press, the board did so to “address the personalized, digital age education that K-12 public school students need to be successful in college and careers, and as globally engaged, productive citizens.”

Some educators warn that classroom technology can interfere with essential direct human interaction. In 2018, Lander College for Men banned smartphones and laptops from all classrooms. Dean Moshe Sokol of Lander hypothesized the ban would reduce distractions and improve conduct (Lieberman, 2018). Professor Trevon Logan of Ohio State University saw grades rise in his economics course after banning all electronics during class (McKenzie, 2018). Of Logan’s students, “about 25 percent mentioned the policy in their open-ended course evaluations” and endorsed it.

The American Federation of Teachers (AFT) question the place of for-profit educational corporations in classrooms. According to AFT: “the foundation of any successful education system is the trusting relationship among students, teachers, and their support staff” (AFT, 2018). AFT maintains that only educational technology of proven value belongs in classrooms and that “even the most sophisticated artificial intelligence cannot replace the many important one-on-one relationships students need to

advance in school and life.” According to AFT, the human connection in education equips students with “life’s lessons that help students grow and succeed” (AFT, 2018).

Stand Together and Rethink Technology (START) helps families limit children’s use of technology and social media at home and at school. START claims that excessive technology use can impair mental health, social life, and work readiness. Its members seek ways to work collaboratively to instill healthy tech habits throughout the spaces and places families interact” (START 2018). START provides teachers with programs to reduce screen-time in class.

References

- AFT. (2018). American Federation of Teachers. Future of Teaching and Technology. <https://www.aft.org/resolution/future-teaching-and-technology>
- Brotto, G. (2018). The Future of Education Depends on Social Emotional Learning: Here's Why. <https://www.edsurge.com/news/2018-06-04-the-future-of-education-depends-on-social-emotional-learning-here-s-why>.
- Claro, M. et al. (2012). Assessment of 21st century ICT skills in Chile: Test design and results from high school level students. *ScienceDirect*, 59(3), 1042–1053. <https://www.sciencedirect.com/science/article/pii/S0360131512000887#!>
- Common Core. (2019). About the Standards. <http://www.corestandards.org/about-the-standards/>.
- ISTE. (2019). International Society of Technology in Education. North Carolina Adopts the ISTE Standards for Students. <https://www.iste.org/explore/press-releases/north-carolina-adopts-iste-standards-students>
- Lieberman, M. (2018). No Smartphones or Laptops in Class -- Campuswide. <https://www.insidehighered.com/digital-learning/article/2018/09/19/laptops-and-smartphones-class-prohibited-campuswide-small-new>
- McKenzie, L. (2018, May 11). Professor Bans Laptops, Sees Grades Rise. <https://www.insidehighered.com/news/2018/05/11/ohio-state-professors-technology-ban-finds-positive-reaction-and-results>
- Sana, F. et al. (2013). Laptop multitasking hinders classroom learning for both users and nearby peers. *ScienceDirect*, 62, 24–31. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0360131512002254>
- Sawyer, J. E. et al. (2017). Which forms of active learning are most effective: Cooperative learning, writing-to-learn, multimedia instruction, or some combination? *Scholarship of Teaching and Learning in Psychology*, 3(4), 257–271. Retrieved from <https://psycnet.apa.org/record/2017-54979-001>
- Squirrel AI Learning. (2019). How we're revolutionizing education. <https://squirrelai.com/our-story/>
- START. (2018). Stand Together and Rethink Technology. Equipping Parents to Take Control of Tech. <https://www.westartnow.org/strategy>