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Re-evaluation of Technological Tools for Improving Education

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Abstract

This research study will discuss the topic of technology's influence on education for students and how it has and should be implemented in those settings. The level of quality for the educational system in the United States has been stagnant for decades without much serious effort to improve it, and with the pace of technological advancement speeding up in recent years, this disparity is increasingly obvious. Though there are new tools created by innovators for the purpose of bettering the student's learning experience in the classroom, improper implementations and outdated teaching methods and policies are preventing students and teachers alike from benefiting as much as they should. Most standards have been relatively unchanged, and the generalized style of framework for education alienates learners who cannot perform as well with traditional teaching practices.

It is therefore crucial to understand why teachers struggle to utilize newer tools or adjust their teaching environment to best guide their students, and to pinpoint potential ways to improve their teacher-student dynamic with better-suited content and personalized delivery methods. Although the usage of technological tools such as mobile devices and online platforms/applications is becoming more commonplace, its uses in terms of education are comparatively limited. Studies have shown that implementing these strategically to target tenets of student learning such as learning style and mental health already has positive results. By increasing familiarity and proper facilitation throughout the preK-12 levels and beyond, students' psychological and learning needs can be better met. To support these changes, there should be increases in funding and policy adjustments to become more modernized, particularly through the U.S. federal government. If this is accomplished, student interest in learning will increase as it is more conducive to progress and they will be more prepared for their future careers. Other

broader challenges we face such as social injustice, economic inequality, and unemployment will also likely be reduced with these efforts.

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Background

Before delving into the specific applications technology could possibly aid in educational settings, it is important to analyze the previous methods in which it has been used and its effects. Current classrooms often utilize teaching methods that are outdated and do not actively incorporate technological tools, and studies have shown that such tools by themselves do not have a notable positive impact on developing skills such as problem solving, critical thinking, content uptake, etc (Thieman, 2016). This study's purpose is to focus on discussing how K-12 preservice teachers use technology for student learning in reference to teaching standards from the International Society for Technology in Education, and the "longitudinal 5-year study examined work samples and reflections of 223 elementary and secondary preservice teachers in a graduate teacher education program". Below are the study's findings for digital application use in classroom settings:

Technology	Elementary Work Samples: Teacher Use	Elementary Work Samples: Student Use	Secondary Work Samples: Teacher Use	Secondary Work Samples: Student Use
Word Processing Software	51%	11%	58%	12%
Internet Search Tools	44%	18%	44%	27%
LCD Projector	17%	<1%	39%	0
Presentation Software	14%	2%	40%	6%
DVD/Streaming Video	12%	0	17%	<1%
Tape/CD player	7%	0	13%	1.5%
Graphic Organizer	6 %	2%	13%	0
Digital Cameras	14%	0	4%	2.5%
Webquest	11%	3%	3%	3%
Desk Top Publishing	3.5 %	0	8%	1.5%
Web Log	0	0	6%	5%
Video Cameras	2 %	0	4 %	<1%
Graphics Clip/Art	3.5 %	0	3%	1.5%
Webpage/Class website	0	<1%	4%	<1%
Create CD's	0	0	3%	2%
Spreadsheet	2 %	0	2%	2.5%
CD-ROM	3%	<1%	1%	0
Smart Board	<1	0	2%	<1%
Subject specific software	1 %	<1%	1.5%	2%
Email	0	0	1.5%	1.5%
I-Movie	0	0	1%	2.5%
MMP3/Podcast	0	0	1%	<1%
Simulations	<1 %	0	0	<1%
Photo Shop	0	0	<1%	<1%
Computer Games	<1 %	<1%	0	<1%

Fig. 1: *Use of Technology in Instruction by Preservice Teachers and by Their K-12 Students Documented in Work Samples (2002-2007)* (Thieman, 2016)

Based on these data values, there is very little use of technology besides Word processing software, which is an older and therefore more familiar application. Due to its more personal nature of use, it cannot be considered a major contributor to aiding in student learning. In addition, students do not appear to utilize software often, with Internet Search Tools being the highest category. We can infer that there is likely either little incentivization to do so, the provided technological tools are poor in performance, or both. The problem lies in that school administration often sidelines newer computer and wireless technology because they do not possess the experience necessary to ensure its use will actually help students thrive. Despite these bleak circumstances, there is an ever-growing requirement for technological proficiency among students, whether explicitly or passively.

Another crucial aspect of student learning is engagement, as it is closely correlated with content retention. Student engagement can be divided into three main types: cognitive, behavioral, and emotional (Schindler, 2017). Certain applications such as social media platforms, digital games, and web conferencing could have desirable outcomes for students if they are adapted for educational purposes. However, we also need to consider the position teachers are currently in, as they require training to best use these applications. Without the proper knowledge, issues such as excessive screen time, questionable content, tech equity, and tool availability can crop up. By thoroughly evaluating what resources are necessary to build these tools and train staff, we reduce problems that can arise rather than designating loose standards and vague budgets like previous programs. This includes providing teachers with learning resources to raise their digital literacy, and eventually establish a reliable standard bar. One report states that the "most commonly cited reason for lack of technology implementation in the classroom is inadequate professional development and training", which further emphasizes the

importance of proper training (Johnson, 2016). Effective implementation of technology can enable increased productivity, stronger academic motivation, more personalized learning, and greater communication.

The recent COVID-19 crisis highlights a renewed need for tech for educational settings as well. Due to the prevalence of distance learning, classroom's shortcomings are being gradually exposed, particularly from using traditional methods. With classes going online using platforms such as Zoom, it is necessary to consider how these practices are being adopted and the way students as well as teachers are adapting. Normalization Process Theory (NPT) explains this concept, and forms the basis to predict this phenomenon's trends (Goh, 2020). Goh's study focuses specifically on the use of technology in medical education, but the analysis can be extrapolated to general classrooms of all kinds. The pandemic generated significantly higher demand for new solutions to problems in distance learning environments, especially issues such as a lack of effective educators and quality content delivery methods. In order to compensate, we can expect to see increased usage of technological tools rather than revert to previously applied methods. Therefore, it is even more crucial that policies are adjusted and standards for teaching raised.

Methodologies & Tools

Through effective implementation of technology for classroom use, we can expect to improve the quality of education at all levels. To do so, we must evaluate what tenets of learning should be targeted by new technologies, the first being a criminally overlooked part: personalized learning (PL). PL activities should be built from a student's learner profile, with information such as their preferences, strengths and weaknesses, goals, and a curated roadmap

(Alamri, 2020). Ideally, these components should be used to allow the student to construct new knowledge and understandings based on their past experiences, which is a concept of learning called constructivism (Ratheeswari, 2018). Constructivism theoretically is more effective for student learning than the more familiar behaviorism, which is generalized and does not factor in any of these specific data points. By utilizing PL activities, students can become more aware of their own learning style relative to others in a non-competitive manner, and stay motivated long-term without burning out. PL activities would also promote students' self-determination of their futures, helping to boost their mental health.

Providing information and communication technology (ICT) to support access to these applications should also increase these effects (Herold, 2016). This can be achieved by having students use their own devices or be provided with school-owned ones. Without teachers that are experienced in using these devices and the platforms, however, this framework will not be enough to help students. This readily available access is known as 1-to-1 computing, which describes the idea that providing students with devices will improve their technological literacy, and increase their complexity of work. It also allows institutions to have a better grasp on what students know and improve communication between staff, students, and even parents. Applying PL activities through platforms and equipping students with 1-to-1 computing contributes to the more realistic case of blended learning (BL). BL combines the proposed newer technologies with traditional teaching methods, like lectures, assigned supervised work, mediated learning, etc. We note that BL is a comparatively realistic case since technology usage does not have definitive benefits to academic performance, and only seems to bolster self-directed learning and engagement. One attempt to provide access would be when the Federal Communications Commission (FCC) composed a list of goals and regulatory changes in 2014, aiming to supply 1

Gbps per 1000 students and other measures to give remote and rural schools fiber optic cables with more affordable internet connections (Herold, 2016). The FCC's changes should be built upon in the future, as technological resources such as reliable internet connectivity are still gatekept by affordability and availability. Instead of requiring archaic textbooks and needing to outsource much of their class activities, schools should plan to provide the aforementioned hardware and software with open educational resources (OER). OER such as online textbooks and centralized content significantly aids in educating students, and due to their digital nature, they boost ease of access, speed up the update process for books, and incentivize collaboration.

Online courses such as Coursera, Khan Academy, and even Youtube tutorials already provide sufficient content for learning, and have the added benefit of being available anywhere. They are essentially a proof of concept, that investing into creating similar online courses and content will help contribute to creating a digital standard that is more credible. Structured online educational portals have already been in use, referred to as learning management systems (LMSs) like Blackboard, Brightspace, and Canvas (Rosenbusch, 2020). These are commonplace in many educational institutions and are noted to be one of the most important learning tools for students; however, they are often just a remixed way of displaying pre-existing information to the students and certainly have the potential to provide many more resources for learning. Rather than simply transposing the methodology of an in-person class to an online platform, we should aim to provide as many opportunities and learning tools through LMSs as possible.

Effects & Concerns

There are significant difficulties with implementing a conducive online learning system, especially when traditional approaches are fraught with many already, but they can be mitigated

with a hybrid approach. A common issue with creating an infrastructure with technology is that it cannot adapt to the staff, who possess their own traditions and habits and are further handicapped by outdated educational standards and requirements. Currently, a number of schools have found that they may have some degree of access to resources and invest substantial amounts of time into using new programs and apps, but poor results indicate improper planning in the first place. Many institutions still lack a proper transition to digital content, with 70% of preK-12 instructional material remaining in print (Herold, 2016). Assuming devices can be distributed to staff and students, determining the appropriate level of usage and managing said usage is far more difficult, and also happens to be the aspect that impacts quality of education the most. Furthermore, without a proper framework to handle the data available from the devices and a proper approach to making decisions based on that data, education quality will not improve. Thus, it is imperative to determine useful standards to build these frameworks for management in the interest of learning goals, and ensure equity of technical hardware.

We can then use these standards to help students decide how they would best learn and structure the process as a series of choices they make, rather than an immutable path. Their learning roadmap will become more customized and still be compatible with traditional one-size-fits-all designs through blended learning. By prioritizing student choices, however, interactions between instructors and students can be less awkward and unproductive, and become more conducive to a fulfilling educational experience.

Revisions

The quality of education in the United States has been lackluster long since before the advent of digital technology, making change more important now than ever. There is a need to

increase support to integrate new technologies for educational purposes. Such technology can be expected to have the intrinsic potential to collect the data necessary for predictive learning, which is information that is lost in traditional practices. Policies should change to enable institutions to work with schools and staff to increase usage of technological resources, and ensure the transition is as smooth as possible. In addition, standards for teacher training must be brought up to increase the skill level with technology necessary to qualify. Some attributes of student-teacher learning to consider updating include audio/video content, web-based content, and open/distance learning.

In 2014, the FCC approved a program cap raise from $2.4b to $3.9b; within roughly a year, schools and other educational facilities could expect to receive a portion of the increase for wireless network equipment (Herold, 2016). To maintain this momentum, programs like the FCC should approve similar financial adjustments to invest in more research and staffing for a universally agreed open framework for educators and their organizations, then later increase the aforementioned cap to back the distribution of resources and the construction of proper infrastructure for sustained long-term support.

Conclusion

Without adjustment to our education system's practices, the gap between our standards and higher quality education will only widen. Encouraging the use of technology and facilitating its proper implementation should improve student learning experiences, and lay the groundwork for further progress. We must consider the risks of this transition, most notably the lack of reliable research to design programs and frameworks off of. Without proper information, we cannot begin to train teaching staff and expect learner success either. Additionally, the

management of resources online is still in its infant stages; there are no means to guarantee control over information, which poses a large risk for learners and staff alike. By developing actual modern policies and updating old ones, we can spur a new age where technology is accepted rather than neglected, and education can evolve rather than stagnate the way it has for so long.

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