Using Technology to Change Education : Blended Learning in the Science Classroom

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Abstract

This paper intends to highlight the trends in technology over several years and contrast the differences in adoption and implementation between the field of education and the rest of the world. Education has been slow to adopt new practices and continues to remain less technologically advanced than the society it aims to educate. The focus of this review is to call attention to the impact on science education using journal articles and reports in the fields of education, educational technology, and learning and behavioral sciences. By being reluctant to incorporate technology, science educators miss out on the opportunity to enhance the learning of their students using strategies such as blended learning. Blended learning can be a tool that aids in the development and strengthening of the 21st century skills needed by students to think critically, apply learning, and solve real-world problems in the classroom, in the workforce, in higher education, and most importantly, in their daily lives. Blended learning is a strategy made possible by ICT implementation. Successful implementation requires clear vision, detailed and intentional planning, training, monitoring, and adjustment. Leaders should look to the experiences of others to plan for success and avoid pitfalls. Well-planned and poorly-planned technology projects are documented in the literature that can be used as learning examples.

Keywords: blended learning, educational technology, science education, 21st century skills, ICT

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Students spend much of their childhood in classrooms learning various skills and concepts with the expectation that they will use what they've learned to become productive members of society. However, society has changed while our educational system has lagged behind. We are educating digital citizens with industrial era methods, making much of the time spent in school irrelevant to students outside of school. Computers and devices have taken over discussions in education rather than being a tool that is used to enhance learning.

Technology gives us enhanced capabilities for educating learners (Collins & Halverson, 2018), but the physical act of placing technology in classrooms has become the focus. Blended learning is a holistic approach to learning that couples traditional teacher-student interactions with an online component that allows for freedom and flexibility for students and teachers. Blended learning could boost motivation and achievement with the devices already present on campuses.

Blended learning has been called a technology that provides “learner-centered, differentiated educational experiences that better prepare students for the digital world” (Consortium for School Networking, 2019). Blended learning takes advantage of the digital skills students already possess and applies them to learning inside the classroom. Technology can be embraced instead of fought against. It allows for the freedom and flexibility students need to learn. Blended learning uses technology to make educators “more effective at engaging students and working with them as individuals” (Consortium for School Networking, 2019). Allowing personalization, creativity, and innovation in the classroom engages and motivates students while helping them develop the skills needed to be successful in school and beyond. Blended learning

could be the methodology that successfully embeds technology into the classroom and propels achievement forward while providing students with ownership and voice.

Trends in Technology in Education

Ten years ago, The New Media Consortium's Horizon Report: 2009 K-12 Edition, listed the following six trends as having the most significant impact on teaching during the following five-year period:

- Technology continues to profoundly affect the way we work, collaborate, communicate, and succeed.
- Technology is increasingly a means for empowering students, a method for communication and socializing, and a ubiquitous, transparent part of their lives.
- The web is an increasingly personal experience.
- The way we think of learning environments is changing.
- The perceived value of innovation and creativity is increasing. (2009, p. 6)

The report also predicted that collaborative environments and online communication would move into mainstream teaching practices within the next year (p. 4). The challenges included educating students with outdated strategies and materials and the lack of student connectedness to learning (pp. 6-7). Ten years ago, technology had already been identified as being an important aspect of our lives that was changing the way students learn.

The next year, the Horizon Report: 2010 K-12 Edition breaks convention and relists “collaborative environments” as a technology that should be mainstream within the next year because of their “importance to education and of the fact that they have been adopted in part, but not to the full extent of their potential” (p. 6). The challenges identified for the year can explain

this lack of widespread implementation. The report mentions the slow adaptation of modern instructional methods to best serve the new generation of students, uncertainty or disagreement about how the educational system needs to be reformed, teachers' digital illiteracy, and resistance to embrace the technologies students use for learning outside of the classroom (p. 5). The solutions to the problems seen in education were available but seemingly inaccessible.

By 2014, the Horizon Report: 2014 K-12 Edition mentions the expectation of teachers to be adept at using technology (2014, p.6). In the five years between the 2009- and 2014 reports, schools had begun to transform from traditional classrooms into learning centers where technology has a huge presence. Hybrid learning and authentic learning experiences are the next technologies expected to be implemented in schools on a wide scale. Although great progress was made in those years, teachers are described to be “slowly embracing the concept of authentic learning” (p. 20) while simultaneously dealing with a role change and new expectations in this new era in education (p. 6).

The Horizon Report: 2017 K-12 Edition was the last NMC publishing for that educational level. This report shows a definite growth in technology implementation as “coding, STEAM, and innovation” (2017, p. 10) make appearances as key trends and “makerspaces, robotics, virtual reality, and artificial intelligence” (2017, p. 38) are a few of the trends expected to take hold by year 2022. But as education embraced technology, the technology continued to advance. And the challenges that impacted implementation remained similar.

After almost a decade since the first cited report, teachers' roles are still being defined. Schools have a path to improving digital literacy and making learning authentic. And now,

technology's positive impact is being lessened by the achievement gap which was stated as being one of the most critical challenges impeding technology integration in schools (2017, pp. 22-36).

The Horizon Report: 2017 K-12 Edition also provides a chart highlighting the trends, challenges, and developments from the 2012-2017 reports. Teacher roles, blended learning, authentic learning, and personalized learning were each reported for multiple years as being trends or challenges (Freeman, Becker, & Cummins, 2017). In those eight years, the technology became more widespread in society. The expectations for those technologies having an impact were raised higher and higher, but the foundation of education remained the same. The educational system was not designed to educate individuals. Nor was it intended to promote creativity or flexibility (Strauss, 2015) Education has tried to keep pace with technological advances, but the technology is being laid on top of the existing foundation; thus, preventing it from becoming invisible and allowing it to remain the focal point for many.

Blended Learning

Horn, Staker, and Christensen (2015) define blended learning as:

a formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and/or pace; at least in part in a supervised brick-and-mortar location away from home; and the modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience (p. 54).

Consortium for School Networking lists blended learning as one of the top five tech-enablers for 2019 that allows educators to be "more effective at engaging students and working with them as individuals" (2019). Sahni (2019) also concluded that blended learning

was more engaging for students and provided active learning and more personalized learning. Sahni measured student satisfaction with the blended learning approach and found that students appreciated that content could be accessed anywhere and at any time and that feedback was immediate (2019). Students want to feel in control of their learning. Blended learning affords students the opportunity to control access, pacing, and content.

Similar to Sahni's (2019) findings on satisfaction, Alsalhi, Eltahir, and Al-Qatawneh (2019) found that students who were taught science using a blended learning approach not only had positive attitudes towards the course but also had higher levels of achievement. Students in blended classrooms undergo a shift from passive to active learning because the focus of the class is no longer the teacher in the front of the room states Kaur (2013). Kaur also describes blended learning as providing flexibility to students and teachers by allowing students to choose their mode of learning and gives teachers the space to personalize instruction (2013). So even though there is a significant digital component to this method of learning, the student and teacher relationship becomes more meaningful and effective.

The benefits of a blended classroom do not solely change the student-teacher relationship. The student-student relationship is also altered. Blended learning has also been shown to increase students' retention of scientific concepts and eliminate gender achievement disparities in science (Suleiman, Salaudeen, & Falode, 2017). Plough (2017) explains that the student in the blended learning classroom engages in interactive learning. Students are expected to collaborate, engage in dialogue, and debate. Students who would normally not participate nor feel comfortable sharing in a traditional classroom are given a voice in the blended classroom (p. 28).

Blended Learning in Science

In science classrooms today, there is a struggle to provide quality formative feedback and individualized lessons while still providing engaging and interactive opportunities for students to explore phenomena. Providing different means of content delivery in science courses may enhance student engagement and motivation (Stockwell, Stockwell, Cennamo, & Jiang, 2015). Secondary teachers often teach 100-200 students a day. The time for immediate feedback that can inform students and drive instruction is minimal due to quick pacing and importance placed on improving school, district, and state assessment scores. The result is that students do not get to improve where they struggle, and teachers do not have the chance to provide interventions or enrichment to neither struggling nor successful students. Activities lose their importance and become marks in the grade book. Students miss out on interacting with and manipulating information in relevant ways. Science is taught but not often done.

The science classroom can be a blended learning environment that allows students the opportunities to learn using various types of content while still having daily access to a knowledgeable educator who can tailor instruction and activities to each student's learning needs and interests. Incorporating a digital component to the science classroom gives students access to simulations not otherwise capable due to financial, time, or safety constraints. Students will also have the ability to choose the mode of their supplemental instruction and are able to control pacing.

For the teacher, a blended science classroom allows for immediate and frequent formative feedback. Students can easily be assigned activities that address their weaknesses and

their progress can be monitored. Likewise, students that need additional challenges can receive the level of instruction that they require. The teacher also has the freedom to choose online simulations and observable phenomena that students would normally not have access to so that students have some interaction with scientific concepts that they encounter in the curriculum.

Providing a digital learning experience would benefit students by teaching them 21st century skills and how to use technology in a way that promotes literacy and learning. Students would be exposed to several modes of learning and content delivery. Having access to digital assessments would provide students and their families with constant progress monitoring.

Blended learning has the potential to make science real in the lives of students. Simulations and virtual laboratories allow students to observe scientific phenomena instead of just reading about them. Students have the freedom to move at their own pace and choose the content that is most relevant to their learning needs. Feedback is immediate. Progress is always accessible and known to students, teachers, and students' families. Technology is an important tool but is not the objective. Technology does not become the focus nor is quality instruction replaced. Technology becomes a catalyst for learning and teachers become the guides. It simply makes the impossible possible and brings the world to students. Blended learning is about making the teacher more effective and allowing the student's learning to be authentic and meaningful.

Technology Implementation

Despite the delayed adoption of technology in education, many districts and other academic institutions have incorporated information and communication technologies (ICT) programs. UNESCO (2009) defines ICT as "diverse set of technological tools and resources used

to transmit, store, create, share or exchange information.” The role of ICT in education is learning quality enhancement, increased access to learning opportunities (UNESCO, 2009), and incorporation of 21st century skills (UNESCO Bangkok, 2009).

The success or failure of a ICT-implementation initiative is dependent on several factors. Fritschi & Wolf (2012) state that to be successful, an initiative must have : “visionary leadership and commitment, robust technology capacity, professional development, scalability, policies that promote and support the initiative” (p. 29). Many plans for new technology programs do not consider long-term, ongoing funding for updated devices and infrastructure nor how the technology would be used to support educational goals (Dicknard, 2003).

Development of ICT initiatives in North America generally falls into one of three following categories: school-provided device initiatives, bring-your-own-technology initiatives, or shared-expense plans for devices and broadband access (Fritschi & Wolf, 2012). The needs of the students determines the method used by each district and every individual school.

Providing devices for all students may create a digitally equitable environment, but can also be a very costly option. Fritschi and Wolk state that despite the associated costs, these initiatives have more evidence of increased student achievement. Devices becoming lost, stolen, or damaged is always a possibility and a missing device creates a situation where decisions that affect cost and access need to be made. In situations where devices are not replaced, digital equity is no longer possible.

For schools that allow students to bring their own devices, the project can be quickly implemented at a lower cost. This can free up time and money for professional development, instructional planning, and upgrading broadband access (Fritschi & Wolf, 2012). Students also

start out with an advantage: they already know how to use their own devices. They would only require training on how to use their devices for educational purposes.

However, students bringing their own devices is inherently inequitable. Although 75% of teenagers have their own phone (Fritschi & Wolf, 2012), not all do, nor do all students have a smartphone. The educational software and applications chosen for instruction may not be available nor work on all devices. And due to stigma surrounding lower socioeconomic status, it also might be difficult for a student to admit to not owning a device.

Even if cell phone equity was not a barrier, most cell phone policies in schools are restrictive (Fritschi & Wolf, 2012). School administrators, teachers, and even parents also have to be convinced that allowing students to use their own devices in the classroom does not have to be disruptive. It is up to the leaders to decide that the benefits of mobile learning outweigh the possible risks. With proper planning, each risk can be mitigated or completely avoided.

Without a clear and focused vision, it is hard to make education the focus instead of the technology. Leaders should identify their goals to effectively plan for innovation and to gain support and input of stakeholders. The literature is filled with studies of poorly- and well-planned attempts at ICT implementation.

LAUSD 1:1 iPad Program

In 2013, Los Angeles Unified School District (LAUSD) began implementation of its 1:1 iPad program. The entire program would cost \$1.3 billion. During the initial rollout in fall of 2013, the district bought 43,261 devices for 47 of its schools (Laowsky, 2015). The program experienced many problems and received a lot of bad press due to the apparent failure and costs.

There were investigations, lawsuits, and resignations as a result of this costly attempt at technology-integration (Lapowsky, 2015).

Problems did not take very long to surface. As stated by the Los Angeles Times weeks after the initial rollout, students were able to bypass security features, or even take advantage of the lack thereof. There was no uniform policy on home use of the devices which meant that some schools required the devices to remain on campus; while others allowed students to take them home (Blume & Ceasar, 2013). In addition to student misuse, some schools had to battle poor internet connectivity even though \$800 million of the budget was allocated for network upgrades. The facilities chief was not a part of the upgrades planning process (Newcombe, 2015).

In addition to spotty internet, the digital curriculum provided by Pearson proved to be unreliable. The initiatives's director claimed that only 5% of students had access to the curriculum at any given time (Lapowsky, 2015). There were also complaints that the curriculum was not available for most of the school year, content uploads took a long time, all content areas were not represented, and lessons were not rigorous enough; thus, creating a situation where the curriculum was rarely observed in use (Margolin et al., 2014).

However, LAUSD's attempt was not a total loss. As a result, districts and institutions around the world have another program from which they can and learn. Apple also revamped its large-scale deployment after this high-profile blunder. Apple's Device Enrollment Program (DEP) now allows IT administrators to manage devices remotely without having to physically connect each device (Chambers, 2014). DEP also offers automated device management, wireless supervision, zero-touch configuration, and streamlined setup assistant (Apple Deployment

Programs, 2017). These features should help prevent student and teacher misuse of devices (Margolin et al, 2014, p. 85-86), eliminate the chaos of deployment, and get devices into the hands of students much quicker.

LAUSD's problems during implementation highlights the value of having a clear vision that leads to intentional planning. The district's superintendent at the time believed he needed to "quickly get devices in the hands of poor children to close the achievement gap" (Lapowsky, 2015). The superintendent identified a problem but erroneously made the technology acquisition the solution instead of a tool to supplement educational goals. He stopped short of designing and committing to a long-term plan that would focus less on devices and applications and more on teacher training, instructional support, deployment staff training, infrastructure improvements, and overall quality of instruction (Margolin et al., 2014).

Summit Learning Program

The first Summit School opened in 2003 Redwood City, California. It was already considered a transformative and innovative school eleven years later when the CEO decided that the 55% of students that earned a bachelor's degree was too low of a number (Jacobs, 2018). The next year, the school revamped itself and developed a personalized, self-paced, and "self-directed" (Jacobs, 2018) instructional model to prepare students for the difference in levels of support from high school to higher education. This program made use of technology, but it was not the focus, and much of the learning was designed to be collaborative and project-based, and cognitive skill development was a focus (Jacobs, 2018).

The school soon became a focal point for other schools in the state due to its success. Milpitas Unified School District had already successfully implemented blended learning using a

rotation model with Chromebooks for its students to keep costs low (Lapowsky, 2015). Despite the success, in 2015, the Milpitas Unified School District piloted the SLP at one of its campuses, Marshall Pomeroy Elementary (Jacobs, 2018). Because the school already had blended learning in place, teachers were skilled at technology-integration. Instead of lack of training and buy-in being an issue, teachers struggled with having the time to incorporate program features such as personalized learning time, mentoring sessions, and an inadequate mathematics curriculum. Despite these challenges, the teachers devised workarounds for the time management issues, and Summit immediately addressed the curriculum concerns (Jacobs, 2018).

Due to its flexibility and open-source platform, the SLP is spreading across the country. According to Tom Arnett (as cited in Jacobs, 2018), it is considered an integrated learning system in which the technology and instruction are developed together and create a situation where schools can choose the parts that work for them and modify them to fit their own needs.

Global Implementation

The United States's innovations are the catalyst for changes in the educational systems of countries abroad (Serdyukov, 2017). Other countries have embraced technology as a way to increase the achievement of students, to prepare students to be successful members of a digital and global society, and as a means to provide an education to those who have had little opportunity or access to one.

Sri Lanka. Palagolla and Wickramarachchi (2019) conducted research on ICT implementation in secondary school in the North Central Province in Sri Lanka. Their goal was to identify barriers to implementation and how those barriers affected teacher performance. Sri Lanka is not new to ICT as its integration has been national policy for four decades. The research

showed that ICT usage was directly related to the amount of ICT education and training a teacher had. In other words, high usage was mostly seen in teachers who had received more education and training (p. 112). Teachers who reported higher technology use most often performed better at their jobs. English-language proficiency also had an effect on ICT usage due to most computer and technology-related materials only being available in English (p. 113). And in spite of the acceptance and push for ICT by the Sri Lankan government and education authorities, the infrastructure and resources in rural areas is not accessible nor adequate (p. 112).

Sri Lanka is an example of the issues that could arise in an area where educational technology has already been embraced and is already integrated into the classroom at varying levels. Planning for ongoing support and training would keep teachers confident and proficient in their skills. Continuous monitoring and adjustment would identify problems before they cause subsequent complications.

Philippines. As documented by UNESCO Bangkok (2009), the Philippine government created the eSkwela Project to combat the absenteeism of school-age individuals, poor graduation numbers, lack of education due underfunded general education as a whole. The focus of this project was to provide out-of-school individuals with an education using technology via “community-based e-Learning Centers or eSkwela Centers” to make them successful participants in society (UNESCO Bangkok, 2009). The eSkwela Project implementation plan was especially detailed and consisted of five main components: customized instructional model, infrastructure deployment, community mobilization and involvement, stakeholders’ training, and progress monitoring and evaluation (UNESCO Bangkok, 2009). Detailed plans aid in implementation because they give involved parties a guide to follow. The eSkwela Project was able to use their

plan to track and report progress during deployment. The same plan outline was used to document adjustments and recommendations for improvement.

There was no rush to get the project started. UNESCO Bangkok reports that the project was first presented to the department of education in 2005. Over the course of two years, community mobilization events were held where stakeholders were informed of their respective roles. Contrast this with LAUSD's planning that lasted months and was approximately a year from announcement of the new initiative to Phase 1 of the rollout. (Newcombe, 2015). Stakeholders in Los Angeles also reported unclear job expectations (Margolin et al, 2015).

Despite adequate planning, there were still obstacles to overcome for eSkwela. Leadership and stakeholders conducted SWOT analyses to assess performance and plan for solutions. For instance, many teachers reported being undertrained and uncomfortable with the incorporation of technology. As a result, there is a plan to provide better teacher training. The availability of learning modules lagged behind the need so there is a plan to develop more modules.

It is inevitable that any new innovative project will have its problems, but there were successes that will likely increase the sustainability, long term success, and spread of the initiative. The community, teachers, students, and leadership have experienced the opportunities allowed by integrating ICT into education. Teachers discovered that while challenging, the technology could transform learning into something fun and interactive. Students were given the chance to learn outside of formal education, and many worked on new skills. (UNESCO, 2009).

The eSkwela project was able to remain a viable solution to the identified problem of undereducation in the Philippines. The stakeholders continue to remain involved and influential

in the process. Their assessment and reflection is crucial to the project's ability to remain relevant and focused on the goal. The project maintains a continuous monitoring and adjustment process on every level of implementation that is needed for continued success.

Latin America. Lugo and Schurmann (2012) assert that technology is not an unfamiliar sight in education in Latin America; however, using mobile technology as an instructional tool is. Most of the focus on educational technology is computer-based as mobile phones have not been accepted as an educational tool. As a result, most ICT in schools follows the lab model. In the lab model, a dedicated computer room exists on campus. This model is cost-efficient because a school only needs to purchase a class-set or enough devices to fill the room (p. 17). Computer time would likely need to be reserved due to campus sharing of the same room of devices. Another model is the classroom model in which each classroom has one or two computers. Individual student access is limited in this model, but the teacher can plan digital activities that require group work (p. 18) or stations. The model that provides the most access can be the most expensive: the 1:1 model. This model puts a device in every student's hands. It can be accomplished without purchasing a device for every individual. A lower-cost option is the mobile classroom which consists of carts of devices that are rotated amongst teachers (p. 18). Much like the computer lab model, this option would require scheduling, but it would mean that the entire class could participate in the same digital activity at the same time.

What Worked?

Projects that were the most successful had leaders that valued having a vision. Their vision's did not end with the technology. Summit wanted to improve its students' college

readiness and graduation rates. The Philippines focused on getting its least educated citizens an education and skills that would ready them for life in a 21st century society.

Milpitas found a way to increase access to technology without the cost of buying a device for every student. Rotating and sharing devices allows teachers to incorporate digital activities into their planning without the worry that some students will not have devices due to being lost or stolen. Device sharing also cuts down on the likelihood that there will be widespread misuse of devices. Providing students with devices allows for remote monitoring and updating of devices by IT administrators.

Detailed planning as seen in the Philippines's eSkwela Project gives direction to all activities and people involved. The planning was also not rushed and was specific to the situation. This was also seen in Summit and Milpitas. This tailoring is what has allowed Summit's Learning Program to spread across the country. Good planning involves the people involved, and their input is key to success.

What could have been done Better?

Before planning, the leadership of LAUSD should have decided upon their vision for their schools. The area needing improvement should have been identified and the solution should have consisted of instructional changes before technology was plugged into the plan. There was such an overfocus on getting the iPads to students that there was no plan in place for what happened next.

LAUSD serves as an example of what things need to be planned for and anticipated when a large rollout of devices is expected. Education and training are important for staff, students, and their families to get everyone onboard, understand the goals of the project, and to give

ownership so problems like misuse and missing devices do not hamper progress. Ineffective teacher training appears to be a widespread problem that could be addressed with ongoing training opportunities and on-site support.

How to Apply the Lessons Learned?

Any organization looking to positively impact student learning via technology-integration should first identify their purpose that includes how to create a change from the present situation. Leaders should review other attempts at integration to determine the factors that increased success, those that need to be avoided and how to avoid them, and how it can be adapted and used by their own organization.

The planning needs to start with educating stakeholders so they can join in on the process early so they are not just completing tasks for someone else but behave intentionally to help meet the goals of the project. The technology needs to be vetted to ensure that it will aid in solving the problem and enhance instruction that is already effective. Planning needs to address future funding for upgrades, repairs, and training because devices, applications, and software will become outdated and may need to be adjusted due to changing needs.

Class sets of devices appear to be the best option for those looking for 1:1 solutions. This means that digital equity can be created and maintained because the probability of devices being lost, stolen, or damaged lowers. This solution also allows for remote IT administration. Teachers and students would use the same versions of devices and applications so the only differentiation would have to be for instructional purposes and not technical ones.

However, districts should consider relaxing cell phone rules to allow some progress towards equal access in situations where 1:1 is impossible. If the goal is to create life-long

learners with 21st century skills, then students should be allowed to have access to the same tools used for learning outside of school. Students can be taught how to use their devices responsibly. This would provide opportunities for learning in the classroom and allows students to have access to learning materials, engage with peers, and extend their learning outside of the classroom.

Due to sudden changes made in instruction currently, planning for ICT implementation may possibly have to be refocused on those technologies that can be used to supplement instruction, strengthen skills, and close gaps. Pellini, Hub, and Jordan (2020) identify several technologies that may have to be employed during prolonged remote learning such as open educational resources, gamification to maintain student attention, and lower bandwidth instructional activities for those students who do not own smartphones. The authors also give possible solutions for identifying learning gaps using personalized learning technology and closing them with appropriate technological solutions.

Possible gaps in the research

There is no standard of measuring success of any program. Much of the qualitative data is self-reported. Any change in quantitative data cannot be proven to be a direct result of technology use. Also, there is often no subsequent research done to assess an organization's progress since the initial research. Updates would be valuable for those looking to implement similar programs.

Questions for future study

Will the switch to remote learning increase the acceptance of mobile learning across the different educational levels? Will there be an increase in blended and flipped classroom models

when face-to-face education resumes? How will the infrastructure need to be adapted to manage the increase in mobile technology usage? How will schools address personal devices in the classroom after requiring many students to use them for educational purposes? Will teacher attitudes towards technology become more positive?

Historical patterns and Current Concerns

Since education generally lags behind society as a whole as far as technology is involved, we can expect that technologies that have already been embedded into our lives will become relevant in education years after. The 2020 EDUCAUSE Horizon Report lists Artificial Intelligence (AI) and Extended Reality (XR) technologies to be two of the most important trends in education right now (Brown et al, 2020). The Horizon Report: 2017 K-12 Edition listed those two technologies as being two key trends to watch. In the three years between these reports, those technologies remain in the same state of limited adoption.

The current state of affairs has thrust technology into an important tool that keeps our society functioning. Politics, business, education, and much more have been almost completely digitized. Perhaps necessity will be the true accelerator that allows for the field of education to lead in innovation instead of having a three-five year reaction time. In 2014, the Horizon Report: 2014 K-12 Edition predicted that hybrid learning and authentic learning experiences would be mainstream, and teachers would be skilled at using technology. In 2020, enough teachers were untrained on technology to require emergency training sessions prior to districts providing remote learning (Castelo, 2020). While implementing ICT is difficult even when adequately planned, the World Bank (2020) suggests that schools that had already embedded technology into instruction and had teachers and students who were already familiar with the digital learning

aspect of remote learning will likely fare better than those that had no significant technology-integration and teachers untrained on how to use technology.

Technology has the potential to transform education around the world. Incorporating technology into the classroom allows for creativity, collaboration, problem-solving, and personalized educational experiences. Present-day society requires citizens that are digitally literate, flexible, and critical thinkers. Technology can be used in a blended classroom environment to develop life-long thinkers who possess the important skills needed to live, learn, and work in the world. The success of technology in schools is dependent on the vision of strong leadership, school community involvement, ongoing training, consistent support, and continuous evaluation and adjustment. UNESCO (2009) believes that by recognizing and sharing successful innovation in education, it would encourage more innovation by others who gain insight from the successes and failures of other programs. Learning from the experiences of others is not just an educational strategy, but an innovative one as well.

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