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# THE GOOD, THE BAD, AND THE UGLY

## A Broad Look at the Adaptation of Technology in Education

VLADISLAV ILIN

Universidad de los Andes, Colombia

KEY WORDS

*Technology*
*Education*
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*User Experience*
*UI*
*UX*

ABSTRACT

*Technology in education is a global phenomenon affecting learners of all ages. The breadth and variety of available tools make it difficult to implement a standardized method for assessing the impact of technology on learning. The lack of a consensus on good and bad practices results in inconsistent application and mixed learning results. This article examines the adaptation of technology to education and the various tools used to enhance learning. A discussion of the advantages and disadvantages of using technology in education, as well as a review of methodologies for evaluating their impact is included. Problems associated with the way technology in education is evaluated are identified. Suggestions for further research to address those problems are included.*

GLOBAL KNOWLEDGE ACADEMICS

## 1. Introduction: Why Technology in Education?

In my first year of teaching at a university, I had a class of fifteen international undergraduate students. My previous experience was working with professionals that spoke the same language, both lingua franca and technological. During office project discussion, I typically disseminated information to my team in a lecture-type format without having to elaborate on jargon or fundamental principles of the project. During my first university lecture, looking at the blank faces, I realized that lecturing was not the optimal method for disseminating information. Most of my pupils were confused, but for very different reasons. Some were not native English speakers, others came from a culture that prohibited them from asking questions, some had no foundation in the subject, and others were just not interested in the topic because they could not relate it to their lives. Only a small fraction of students that were engaged, dominated the class discussions. To reach every student in the classroom, I altered my teaching approach. Instead of lecturing, I adapted a more personalized approach to disseminating information. This method worked so well that within a few terms my classes were full, with a waiting list. With forty students per class, I found it difficult to dedicate enough time to each group and giving each student meaningful feedback. After a few problematic semesters, I started conceptualizing a technology-based tool that would facilitate learning and be adaptable for the individual's learning style and my primary motivation for exploration of the application of technology to learning.

## 2. Learning and Technology

Catering to the learning needs of an individual is not a novel approach. Psychologists like John Dewey, Jean Piaget and Lev Vygotsky all emphasized the importance of individual needs in development. Although their particular theories vary, they are considered to be the founding fathers of the Constructivist approach to learning.

Constructivism approaches learning from an individual's framework. The individual constructs knowledge rather than passively absorbing it. Traditional learning relied on a positivist approach where the teacher was the source of information, and the students are passive learners. Constructivism rejects that notion, stressing that culture, experience, and ability play an essential factor in the learning process. Instead of being told to memorize facts, the learner connects new ideas to their existing knowledge.

I employed a constructivist methodology in my teaching by employing the following strategies:

1. Real-world case-studies allowed students to connect abstract concepts to tangible examples.
2. Students learn about technology, building on their previous knowledge, through technology rich course projects.
3. Students were allowed to select topics relevant to their interests.
4. Working in small groups changed the classroom dynamics and allowed students to
   a. Cooperate and share ideas
   b. Support each other
   c. Present projects to their peers. (Students use language and concepts that are easier to understand to their peers)
   d. Offer constructive feedback
   e. Develop, present and justify their project, rather than passively absorb knowledge, which in turn, encouraged deeper understanding and a more meaningful learning experience
5. This process also changed the role of teacher as a facilitator rather than the "go-to person". I intervened only when I saw poor decisions, and I did so by asking questions to provoke thought, rather than telling them what to do.

By applying the aforementioned constructivist strategies in my classroom, I found that its flexibility and individual-focused approach creates a richer educational experience for students. Technology offers multiple ways to connect, collaborate, build community, access information, engage and personalize the delivery of information, facilitating the implementation of constructivist methodology into learning. Using technology is convenient and often more accessible than the traditional methods of learning. It is typical to find students using computers to do their research (Henderson et al., 2015) rather than scanning microfilm or using the Dewey decimal system to find books in the

library. Students using technology benefit from various ways of accessing the learning materials, including videos (Henderson et al., 2015), podcasts (Lai & Savage, 2013), blogs (Garcia et al., 2013), and e-text (Sun & Flores, 2013); giving them greater flexibility in learning, more choices of content as well as how and where they learn (Lumpkin et al., 2015).

The benefits of learning through technology have resulted in significant public investment in their implementation (Latif, 2017). U.S. federal and state governments have invested billions of dollars into various educational technologies (Keegan et al., 2008). Most members of the European Union, as well as other developed nations, have committed millions of euros for the integration of digital solutions (Adkins, 2011). Developing countries are also starting to embrace, or have taken steps into employing technology in learning. For example, Malaysia has invested in m-Learning creating the Open University of Malaysia that caters to learners in remote regions and to those who cannot attend live lectures (Njagi et al., 2015). Researchers from developing nations in the Middle East (Izadpanah & Alavi, 2016), Asia (Joan, 2013) and Africa (Adeyemo, Adedoja, & Adelore, 2013; Mtebe & Raisamo, 2014; Bachore, 2015) are lobbying for their respective nations to invest more into Technology in Education (TiE).

The use of technology in education has attracted researchers to look at this phenomenon. Their work offers insight into a variety of technological trends, benefits, and shortcomings. Unfortunately, there are no standardized methods for evaluating technology, and the breadth and width of topics make it difficult to structure and assess TiE as a whole. The next section will describe the literature selection process, followed by a breakdown and categorization of those works into digestible information blocks.

## 3. The purpose and methods

The primary objective of this literature review is to explore the current state of Technology in Education (TiE). The initial search in Education Resources Information Center (ERIC) for keywords of "technology in education" and "technology and learning" returned over 50,000 results. To narrow down the results I selected two filters, namely, articles published in the last five years and peer-reviewed articles.

The modified result yielded over 1,000 articles. To keep the materials relevant to the topic of TiE only articles that fit into one or more of the following criteria were selected:

- Advantages of using TiE vs traditional methods
- Application of a tool(s) to a specific discipline
- Teaching methods using technology
- Users of TiE (age, location, discipline)
- Measure/evaluate the effectiveness of a tool or technology
- Perception of (TiE) by students and teachers
- Setbacks in the integration and application

The resulting articles were entered into a spreadsheet and Thematic Analysis was employed to develop categories. Clarke and Braun (2012) describe Thematic Analysis as a "method for systematically identifying, organising and offering insight into patterns of meaning (themes) across a data set" and offer six steps for the process

1. Know the data
2. Generate codes
3. Search for themes
4. Review Themes
5. Define and Name themes, and
6. Produce the report

Thematic Analysis being a systematic approach to data analysis, with theoretical flexibility, made it a powerful tool for generating categories to structure the results. The findings are discussed in the following section.

## 4. Findings

### *4.1. TIE is a global phenomenon*

The selected articles were in English and came from all over the world. I was especially surprised to find that developing nations were equally active in researching TIE as developed nations. Nearly half of the initially selected (forty-six) articles came from the developing world, demonstrating that institutions and governments

all over the globe see tremendous value in the development and implementation of technology.

Although Spanish Speaking Countries are not well represented in English language literature, during the GKA Edutech conference in 2019 I met many individuals from various South American countries and Spain that were involved with TIE. Based on presentations, posters and conversations, it is clear that for many Spanish speaking nations, TIE is a priority, and educational institutions are integrating TIE into the curriculum on every level.

### *4.2. TIE is for students of all ages*

The majority of the research articles focused on higher education. My suspicion is that this is the case mainly because university students are the most accessible to researchers, and there is more funding available in this realm. Having said that, a surprisingly large number of tools are specifically designed for toddlers and children. There is also a multitude of unconventional ways that technology is used for learning. TIE has also played a pivotal role in lifelong learning. Online tools have opened up opportunities for working adults to learn new skills and fit learning into their busy professional lives.

### *4.3. TIE is comprehensive*

There is a variety of technological tools that cover a broad range of subjects including mathematics, second languages, sciences, arts, writing, engineering, medicine, as well as, aid in learning about other cultures and social diversity. This is significant because of TIE impacts the way people learn in nearly every discipline.

### *4.4. TIE takes a variety of forms and utilizes multiple platforms*

TIE takes many forms. There are too many tools and platforms to mention, the list below summarises the predominant themes in the reviewed studies:

- Discipline-specific applications - include tools that are designed specifically for the subject or tools adapted based on availability or convenience.
- mLearning - the application of mobile technologies for learning, typically applied in settings where access to the institution is cumbersome
- eLearning - courses where the entire learning process takes place online. These often utilise media such as e-text, audio and video to deliver the information and utilise communication tools such as blogs, forums and chat to facilitate communication between students, as well as students and teachers.
- Blended learning - is the mix of eLearning and face to face interaction. At the core of blended learning is Learning Management Systems (LMS). The LMS allows users access to tools, course content, forums, and various other functions that facilitate learning. LMS are discussed in detail in §2.2.4, but it is worth pointing out that they are one of the major themes in the literature and the most commonly used TIE.

From the literature review, it is clear that TIE has a significant impact on and plays a vital role in education. Using TIE to learn is a worldwide phenomenon, implemented for people of all ages in a variety of subjects. The next section examines the positive and the negative aspects of using TIE for learning as well as barriers to implementation.

## 5. The good

### *5.1. Real-world relevance*

The discussion of the benefits of technology in learning should start with its significance to real-world applications. Technology is part of our daily lives (Camposa et al., 2015). In order to learn through technology, it is essential to understand how to use it. Understanding the benefits of using technology to learn is fundamental to twenty-first-century existence (Scalise, 2016). The goal of education should be to prepare for the future (Sun & Wang, 2014; Kathleen, 2016) and schools have responded by integrating real-world practice into their classrooms. Podeschi (2016) successfully applied this principle to the curriculum for a university

information technology course where students developed a project for a real client. This approach to learning gave the learners hands-on training, problem-solving and experience with client management. Employers look for technological prowess in their staff (Snape, 2017). Tools like email and word processing are standard, and industry-specific tools are an integral part of the working environment. O'Brien and Hamburg's (2013) underlines the importance of the utilization of technology in learning for small businesses to stay competitive. Utilizing web-based resources such as blogs, learning networks, wikis, and video tutorials to solve work-related problems leads to better job satisfaction, acquisition of new skills and better business practices.

### *5.2. Community building, cooperation, and engagement*

Working with other people is another essential skill for the real world (O'Brien & Hamburg, 2013). Technology allows people to collaborate on projects and create meaningful communities that encourage mutual growth (Mukama, 2014). An example of cooperation through technology is Garcia et al. (2013) a case study of the implementation of blogs into the undergraduate curriculum in graphic design and illustration. The researchers examined how students communicate, collaborate and form peer communities. The teachers took a step back from the official role and let the students work together, critique, and learn from one another. Working together via blogs students were able to develop individual skills, critical thinking, and reflection about other people's work, abilities that are sought-after in the classroom and career. A similar study by Lawrie et al. (2014) with over one thousand college students using the iCAS[A1] tool to learn science supports the conclusion that learning through collaborative technology not only an effective pedagogical strategy it also helps develop cooperation skills.

In addition to facilitating learning, collaborative technology can make learning fun and interactive. The integration of media into teaching has yielded positive results. Coskun (2017) introduced interactive learning through video production for seventh-grade science students. The goal of the project was to get students to collaborate through making videos that explain the scientific phenomenon to their peers. The theme of the video had to be in one of the following formats: news report, symposium or movie. The results were overwhelmingly positive. Students felt engaged, learned from their peers using technology in career-oriented presentation and most importantly had fun. Fun in learning is especially important for younger students, as Camposa et al., (2015) demonstrated in their study of primary students collaborating on an e-book to learn mathematics. Using technology students become active participants rather than passive users. The active role empowers students by letting them become the storyteller, scientist, or researcher.

TiE opens unparalleled opportunities for people to interact and build communities. People with dramatically different, backgrounds, skill sets, and interests can become part of a community through collaboration (Njagi et al., 2015). There are numerous advantages to implementing technology in learning, students work together and learn from each other while being engaged (Kates et al., 2010). By doing so, they build communities (Mukama, 2014). These relationships allow them to learn more than just skills and relevant knowledge, students learn about each other developing empathy and multiculturalism, diversity and grow as human beings.

### *5.3. Tolerance, Diversity, and Growth*

Learning is not just memorization and reiteration of facts from the textbook (Lai & Savage, 2013). Technology facilitates communication and opens the world of diversity to homogeneous groups. Thompson et al. (2013) bridged two isolated communities in the USA and Korea. To get around the language barrier, they used videos and images to visually communicate ideas about their life to learn about each other's culture.Similarly, Grant and Bolin (2016) looked at how students communicate ideas through collaborative videos in a diversity course. Students found content made by their peers more relatable and are easier to digest than traditional academic reading.

Technology is used to build learning communities, support networks, and facilitate

cooperation. Because technology is a global phenomenon, it is accessible and crosses language barriers. Through technology, people can build connections (Njagi et al., 2015) that result in diversity and cultural growth.

### *5.4. The right tool for the right job*

The previous section discussed how technology is useful for collaboration and learning. Similarly, a well-designed tool can significantly enhance the learning experience. Subject Specific Tools (SST) have been demonstrated to improve mathematics skills (Brasiel et al., 2016), ability in writing (Bodnar & Petrucelli, 2016), language learning (Bluemel, 2014) and various other disciplines.

Brasiel et al. (2016) compared fourteen mathematical tools employed by the state of Utah. They praised features such as step by step tutorials and real-time feedback. The technology allows students to build knowledge immediately in the process of learning. Whether the user makes a mistake, the program notifies them and gives them tips. If the user cannot resolve the problem on their own, the program walks them through the solution. There is no need to wait for a teacher or parent to explain the error, making it a useful learning tool in and out of the classroom. Additionally, this feature also saves instructor time by not having to review every single assignment. The educators especially valued the ability to supervise their students in real-time, internalized reports and self-assessment tools.

In the developing world, the cost of such tools is prohibitive; therefore, technologies are adopted not explicitly designed for that subject to facilitate learning. Liu and Liu (2013) implemented 3D software for learning geometry to better understand spatial conception. While Ambrose and Palpanathan (2018) utilized Google Docs for Malaysian students learning English, using the program's spell and grammar checking functions, as well as the collaborative element that allows students and teachers to work together synchronously.

### *5.5. Convenience, Inclusiveness, and Accessibility*

The previous sections discussed how technology and implementation of discipline-specific tools. This section will focus on multifaceted systems that combine tools and media to provide unprecedented learning opportunities. The best example of such technology is the Learning Management System (LMS). The benefits of LMS have been extensively studied (Sun & Wang, 2014; Kathleen, 2016) and integrated by many educational institutions (Scalise, 2016; Lai & Savage, 2013).

The LMS is designed to build and deliver online learning environments (Lai & Savage, 2013) for any discipline. Although there are various LMS available (Moodle, Canvas, Blackboard), these systems offer similar features. The LMS serves as an online repository for course-specific digital documents, videos, and audio files. External links to online resources such as journal articles, e-texts, and videos are a common practice. Blogs, discussion boards, and wiki are employed to facilitate cooperation. Quizzes, questionnaires, and games offer interactive options for learning. LMS reduces administrative activity by offering course registration, online tests, and paper submissions. Additional features like timetables, calendars, announcements email and chat, facilitate course structure and communication between staff and students.

Studies of LMS use and perception show that reduced time consumption (Sun & Wang, 2014; Kathleen, 2016), as well as the ability to give/get prompt feedback (Lai & Savage, 2013; Lumpkin et al., 2015), are highly regarded by faculty and students. Access to course material outside of the classroom is another significant benefit (Lumpkin et al., 2015). Studying at their leisure, having the ability to review class material later in the term as well as focusing on listening rather than taking notes was crucial to students (Lumpkin et al., 2015) and helped reduces stress (Hewitt & Stubbs, 2017).

The advantage of learning through media (video, audio, and e-text) is prevalent across all studies. The availability of course content in digital format offers convenience, mobility, and accessibility. Videos were especially popular among students who found them informative and useful (Lumpkin et al., 2015). Additionally, media accommodate different learning styles (Lai & Savage, 2013) and offer accessibility options like computer-generated subtitles for videos and conversion of text to speech for

ebooks (Sun & Flores, 2013) for students with disabilities (Hewitt & Stubbs, 2017).

## 6. The Bad

### *6.1. User Tech-Adaptation Level*

Given so many positive characteristics, it would be easy to assume that TiE is good. Unfortunately, there are still many problems that inhibit technology from becoming an invaluable part of education. Technology is relevant to the real world, but not everyone is ready for utilizing technology. Individuals have dramatically different skillsets when it comes to using technology. Frequently, it is assumed that students are "power users", having grown up immersed in technology (Henderson et al., 2015; Thota et al., 2019), but the reality is many do not have enough experience (Sun & Wang, 2014; Hewitt & Stubbs, 2017; Lawrie et al., 2014). The lack of skill causes anxiety and fear (Ouyang & Stanley, 2014) causing students to be disengaged from their curriculum and avoid potentially useful tools. (Sun & Flores, 2013; Izadpanah & Alavi, 2016).

### *6.2. Lack of Teacher Training*

Teacher adaptation of technology faces the same issue. Teachers play a pivotal role in the success of TiE (Thompson et al., 2013; Lai & Savage, 2013; Siraj, 2014). Without training, teachers fail to see the value of technology implementation (Thota et al., 2019), face anxiety (Ouyang & Stanley, 2014) and resist change (Sun & Flores, 2013). The substantial investment of time is a barrier (Hewitt & Stubbs, 2017). Training, as well as the development of online curriculum, is time-consuming and without incentive, which leads to many teachers not wanting to participate.

Although Institutions (Gimeno-Sanz et al., 2014), corporations (Kathleen, 2016) and governments (Latif, 2017) have initiated programs to train teachers in the use of technology and its benefit the methods for measuring the success of these programs are limited. Gimeno-Sanz et al., (2014) and Latif (2016) demonstrated positive teacher reception of educational curriculum but did not follow up on implementation. In order to realistically gauge the impact on the classroom teaching longitudinal studies of the teachers that attend the conferences would be necessary (Claesgens, 2013).

### *6.3. Incorrect Implementation*

Lack of understanding of the benefits of particular tools or poor planning often leads to the incorrect implementation of technology in the classroom. There are several examples where the implementation of technology offers no visible benefits to the learning process. Garcia's et al., (2013) reasons for the implementation of blogs in an undergraduate classroom are not justified. The researchers open with a dubious statement that "currently the manner in which these tools can be best used to promote teaching and learning is not entirely clear". They conclude that through the use of blogs students connect and build peer communities, but their findings do not justify that verdict as during the course a significant number of students were disengaged and immediately after the course completion the blogs were disused. Additionally, the prescribed positive aspects of collaboration through blogs such as the development of critical thinking and reflection of other people's work is attainable through in-class group work, why use blogs at all?

Another example is Camposa's et al. (2015) study of children learning mathematics through e-books. While engaging young pupils with math through drawing is innovative, their reasons for using e-books are never transparent. The technological advantages of e-books are searchability, bookmarks, and mobility, none of these applies to kids' drawings.

TiE implementation requires a well-thought-out process. Although blogs may be well-liked outside the classroom, research into perception finds that students dislike using collaborative tools such as blogs (Lumpkin et al., 2015) and discussion boards (Lai & Savage, 2013). Researchers should carefully consider what tool they are using, and why. Implementing technology for the wrong reasons could lead to student disengagement (Lai & Savage, 2013).

Larger institutions face similar issues. Overwhelmingly positive perception of the benefits of technology resulted in large sums of money set forth for its implementation (Lumpkin

et al., 2015). This phenomenon has led to the technological "arms race" among institutions. Schools want to be seen as technologically cutting-edge to attract more students. The unfortunate result is that administrative pressure (Coskun, 2017) and sales pitches drive decisions rather than research and evaluation.

Even popular tools like LMS have mixed reports of usefulness (Lai & Savage, 2013). The implementation of these systems often occurs without any regard to its users. (Lai & Savage, 2013; Sun & Wang, 2014; Magdin & Tur, 2015). Systems design driven by the administration and IT rather than an understanding of user experience inhibits the utilization of these tools (Khan & Khader, 2014).

### *6.4. It is Personal*

There is also an abundance of personal reasons why technology may fail as an educational tool. Boredom and distractions (Brasiel et al., 2016) play a crucial role in engagement. Parents may restrict access to online tools due to concerns about inappropriate material or bullying (Brasiel et al., 2016). Personal preference is a significant factor. Some students prefer learning face to face (Lawrie et al., 2014) and will feel disengaged in an online course. Disengagement is the primary reason for high dropout rates for Massive Online Courses (Rolfe, 2015). Other students favor remote learning (Hewitt & Stubbs, 2017) may not feel the need to come to the classroom (Lai & Savage, 2013).

### *6.5. Where do we go from here?*

There are a variety of reasons why TiE fails. Technology cannot fix lousy teaching or low student engagement (Lai & Savage, 2013). Training and thought out curriculum are vital factors. The presence of information in technology alone does not facilitate the learning process (Lai & Savage, 2013). Students have to be engaged, and knowledgeable of the systems they use. Without proper implementation and planning TiE takes the form of passive consumption of knowledge (Henderson et al., 2015), losing any advantages it has over traditional teaching methods (Siraj, 2014).

## 7. The Ugly

So what is the verdict? On the one hand, technology is incredibly useful, and on the other, it has many flaws. We can start by looking at how research evaluates the impact of technology on education. As we discussed in "The Good" there are many tools used for many different educational purposes, therefore evaluating the relationship between technology and learning is a significant challenge. A starting point to a systematic evaluation of technology benefit to learning is its ability to redefine an educational task. The SAMR framework developed by Dr. Ruben Puentedura is a well thought out system that splits technology into four categories: Substitution: Technology acts as a direct substitute with no functional change; Augmentation: Technology acts as a direct substitute with functional improvement; Modification: Technology allows for significant task redesign; and, Redefinition: Technology allows for the creation of new tasks inconceivable.

In the context of this literature review, SAMR is used for two purposes:Evaluate the impact of using technology on the learning experience, and Digest methodology used to evaluate TiE.

### *7.1. Substitution*

In itself, substitution does not necessarily render a tool ineffective. A scanned version of "War and Peace" while not offering many functional improvements over the actual book can be quite convenient for mobility. The burden of proof is on the researcher to justify why the technology they are studying is a useful tool.

An example of poor substitution is Liu and Liu (2013) experiment. The researchers assert that substituting pen and paper for 3D software improves the student's ability to learn geometry. In this case, the researchers show little to no advantages to applying technology. The study concludes that it is the 3D aspect of the software helped the students understand the spatial dimension. Compared to pen and paper this is true, but the same "3D effect" can be achieved with simple physical objects. Plastic geometrical objects that could be taken apart, measured, and put back together would be a more cost-effective, interactive and hands-on experience that would

match or surpass the technological tool. There is no compelling proof that the substitution technology for traditional methods is necessary.

### *7.2. Augmentation*

Augmentation is similar to substitution, but the technology offers a functional improvement. Referring to the previous example if "War and Peace" were converted into a digital epub format it could now be searched, bookmarked and highlighted there would be a functional improvement over the scanned version. In applying Augmentation to evaluating TiE the researcher has to be careful in setting up his variable, even if the technology seems inherently superior to a non-technological, in terms of the sheer number of functionalities the researcher still has to justify using the technology.

Ambrose and Palpanathan (2018) set up an experiment to demonstrate the technological advantage of Google Docs for learning English. Google Docs offers several features useful for this purpose including spell and grammar check, the ability of students and teachers to work in real-time on the same document, as well as saved revisions (that allow for comparison to pre-corrected versions). Unfortunately, the control variable is again pen and paper. The researchers could have employed several technological tools used for learning languages and or writing: M-learning technologies discussed by Siraj (2014), or the software utilized by Bodnar and Petrucelli (2016). This study fails to set up a proper control variable that would demonstrate whether this is the right tool for the job, or probe student preferences.

In order to gauge the effectiveness of a tool for learning the research has to compare apples to apples. Brasiel's et al. (2016) research of mathematical tools in Utah classrooms, examines the effectiveness of fourteen different tools designed for the same purpose and applied in similar environments. The conclusions drawn from their research have a stronger foundation based on the methods.

### *7.3. Modification*

The next step in evaluating the impact of technology on education allows for significant task redesign. Continuing from the previous example, in addition to search and bookmarks the epub version of "War and Peace" can also be offered in audio format. The next paragraph examines an excellent case-study evaluating the effectiveness of a tool that fits into modification criteria.

Bluemel (2014) examined a tool called the "Parallel Corpus Teaching Tool" specifically designed for learning the Chinese language. The researcher did not compare the tool to other tools but explored the features of the software and demonstrated how each of them supported language acquisition. The researcher's evaluation of the benefits of the functionality is detailed enough to show a precise and well thought out application of technology to learning. The tool not only defines a word but shows how to structure the word in a sentence, offer an English phonetic version and allows the user to hear the pronunciation. Doing the same tasks without this technology would be cumbersome and require numerous resources.

### *7.4. Redefinition*

The last category of technology creates new tasks inconceivable without technology. Going back to "War and Peace", the reader would be able to ask an artificial intelligence bot questions about the book. For example: "Who was Pierre Bezukhov's mother?"

In section "Tolerance, Diversity and Growth" we discussed how Thompson's et al. (2013) study employed multiple technologies to bridge the gap between two isolated communities in Korea and the USA. To achieve the same results without technology would have been inconceivable. In their own words: "This kind of interdisciplinary, cross-cultural exploration demonstrates the usefulness of technology to bridge content and worlds and the power of the arts to transcend language" (p. 9).

The SAMR framework is the foundation to build the structure that assesses the usefulness or the impact of a tool. The researcher has to understand the impact of the technology they are evaluating and approach the research in a meaningful way to address what and why makes technology useful.

In the literature, many studies asked meaningful questions that yielded significant

conclusions. However, several researchers employed poor techniques. Mtebe and Raisamo's (2014) research into the feasibility of adaptation of eLearning in higher education is one example. Students were asked to rate statements such as: "I would find mobile learning useful in my learning" and "People who influence my behavior will think that I should use mobile learning". Predictably, an overwhelming amount of students positively responded to the potential of learning through mobile technologies. A similar format of data collection conducted by Joan (2013) yielding no surprising results. Without knowing which technology or understanding how it affects learning, it is impossible to assess its value. Gauging public opinions on whether the person views TiE as "good or useful" offers limited insight into the phenomenon.

The same type of questions applied to a specific technology is also ineffective. Izadpanah and Alavi (2016) researched student perception of CALL (Computer Assisted Language Learning). Statements students were asked to rate were such as: "CALL makes lessons more interesting than traditional English instruction" and "CALL helps me develop my grammar" (p 149). The perception of a new tool may change as the user gets bored of it or gets to know similar tools that are better. Properly formulated questions are just as important as setting the valid control variable for the evaluation of the impact of technology.

## *7.5. The Dark Side of TiE*

Several problems with the research and implementation of technology in education were identified. These are described as follows:

### *7.5.1. The Good and the Bad*

Technology is not automatically better. The researcher has to examine the advantages and disadvantages of tools carefully. If the tool does not show significant benefits over non-technological teaching methods, is it worth using given those difficulties with implementation discussed earlier? The researcher needs to examine and justify why this tool is the best approach for this particular type of learning.

### *7.5.2. Control Variable and Questions*

Studies that employ experimental format should carefully choose the control variable and questions for their experiment. In order to gauge the benefit of a given tool, it is much more useful to compare similar tools. If no tools are available, the author can choose to explore the unique benefits of that tool and how it aids the user.

### *7.5.3. User learning goals and personal preferences*

In literature, several studies discussed the personal reasons why users fail to adapt to technology and but very few of them looked whether the technology is adaptive to the user (Sun & Wang, 2014). The question rarely asked is: Does this tool meet the user's learning goals and personal preferences? Though technologies like LMS that have been extensively studied and are well-funded (Kates et al., 2010), the research offers little understanding of the relationship between instructors, knowledge, and students (Lai & Savage, 2013). Additionally, little effort has been made in assessing the individual goals and needs of either students or instructors (Lai & Savage, 2013). The section titled "The Bad" demonstrated that the user disengages when they feel disconnected from the technology. Rolfe's, 2015 research of Massive Online Courses serves as an example of this phenomenon. Massive Online Courses are just too impersonal, resulting in a significant drop-out rate. When the user goals and needs are not assessed instead of the tool designed for the learner, the learner has to adapt to the tool (Henderson et al., 2015). The result is that the success of TiE is varied and inconsistent (Henderson et al., 2015).

The need to look into these questions is underpinned by excellent work such as Lai and Savage's (2013) probe into the relationship of the LMS and student-teacher interaction. Their research looks at technology and its effects on learning and teaching. The in-depth interviews with instructors and focus groups with students' research demonstrated that teachers and students feel that the LMS offers tremendous benefits for learning. The ability to access knowledge online through media such as e-text, video and audio files is acknowledged by the users to be among

the most useful features. Lai and Savage conclude that technology should offer flexible solutions to accommodate the teaching methods, level of technological adaptation, and personal preference. Their suggestion for further research to investigate knowledge acquisition outside the classroom shows a gap in the knowledge worth investigating.

Evmenova's (2018) study of supporting teachers by using Universal Design for Learning (UDL) further underpins the need for learning to be adaptive to the user through the implementation of technology. "UDL is a scientifically based framework for developing curricula that acknowledge learner diversity as a function of human variability" (p 147). UDL approaches learning through three principles: multiple means of engagement, multiple means of representation, and multiple means of action/expression. The researcher uses findings in neuroscience and research on cognitive learning to support the importance of technology in accommodating different learning styles through multiple means of engagement.

Although the goal of the study is to educate teachers, the research itself and the UDL methods employed underline the importance of learner diversity and using technology for diversification of content delivery. Evmenova emphasizes the use of different media (video, audio, e-text) as an effective tool for content delivery for successful learning. The researcher acknowledges the need to look deeper into patterns for using media to study. Her conclusion underpins the need for personalization of learning by stating that the optimal learning experience is a combination of technology meaningfully integrated into the curriculum and flexible, user-centered options for learning.

### *7.6. Adaptive Learning*

Adaptive Learning movement has tried to address this problem by personalizing content delivery to users. Magdin and Turčáni (2015) utilized Educational Data Mining to automate the type of learning material shown to the user based on information stored about them in the LMS. Although this field is promising, developing the perfect algorithm is time consuming, costly and requires intensive research. The authors themselves acknowledge that unique behavioural patterns and the time required for data analysis are limitations to developing a universal formula. Although adaptive learning through data mining is a viable solution, it is still in development.

## 8. Conclusion

Technology-based tools have been widely integrated into the learning process. Videos (Henderson et al., 2015), e-text (Sun & Flores, 2013), images (Kates et al., 2010), PowerPoint (Lumpkin et al., 2015) podcasts (Hewitt & Stubbs, 2017), and a plethora of other tools are used to teach a broad range of topics. From kindergarten to university, various e-learning tools are incorporated into teaching mathematics, sciences, languages, social sciences, computer learning, and a host of other subjects. Web-based Learning Management Systems like Blackboard facilitates communication between teachers and students as well as allow students to collaborate on projects. This phenomenon is worldwide with almost every single nation taking some technological initiative.

Time and resources have been invested in evaluating technologies in education, and survey perception of technology. Lack of agreed standards of measurement often leads to inflated positive ratings of TiE. This phenomenon resulted in a variety of technological implementation driven by clever marketing and hype rather than user needs and personal preferences. The present work identified several of the major problems with the way technology is perceived and evaluated. There is a gap in the research of the relationship between user goals, media use, and learning. Further research with improved methodologies into the phenomenon would offer a more meaningful understanding of how people use technology to learn.

## 9. Proposal for further research

This paper has identified a gap in the research into how individuals use technology to learn. The current trend in TiE is to evaluate how users use or feel about technology to learn. Very few of the studies focus on user needs and motivation as the foundation of technological development. With

the user needs as foundation technology has the potential to redefine learning by personalizing the process (Sun & Wang, 2014). The focus of the research must define the user needs, identify their learning goals and examine how to utilize technology to facilitate the acquisition of learning. Therefore, further research is needed related to examining learning through media outside of the classroom (video, audio, and e-text) and examining how the media is used to achieve the learning goals of adult users.

### *Why outside the classroom?*

The teacher's ability and personality play can dramatically change the perception and use of technology. In order to eliminate this variable, research should be conducted on learning outside of the classroom, and solely on the relationship between the individual's learning goals in the process of learning and media usage.

### *What do you mean by adults?*

Adults in this context refers to individuals enrolled in either secondary or higher education. The advantages of these two groups are that they are more likely to be very familiar with using media, and are more accessible as research subjects.

### *Why video, audio, and e-text?*

Media is technology. Many of the studies discussed here use one or more media as building blocks in their platform for teaching and learning. Learning outcomes are influenced by the complex array of variables associated with various specific technology tools. In addition, other less well understood factors such as the level of user adaptation of the technology tools and incorrect or incomplete implementation may affect teacher effectiveness and student learning outcomes. Interestingly, media may either exacerbate or ameliorate these conditions.

In sum, there is clear evidence of successful learning through the implementation of technology including media. Using media may be seen as fun, it supports learner diversity, and there is clear evidence that it supports learning. However, there is a lack of a clear relationship between how people use it and how this use may vary depending on the individuality and learning goals of the user. This exploratory study has the potential to illuminate some of these dynamics with more rigorous methodologies and practical research questions.

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