Review

How to use educational technology to make education better - Not just different or entertaining!

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Summary. Educational Technologies (EdTech) have the potential to improve learning and teaching both in- and outside of the classroom. EdTech tools can potentially make the education process more meaningful, more engaging, more interesting, more personalized and more flexible. There may be many reasons (changes in school policy, pressures from authorities, observing models of efficient use, etc.) and facilitating factors (support from the school, collaborations among faculty, etc.) driving implementation of EdTech, but there are also barriers (lack of technological tools, etc.) and drawbacks (technological competence, established teaching practices, etc.). In practice, educators are also faced with challenges in designing or integrating EdTech in a pedagogically meaningful way. Most of the time, educators try to effectively implement EdTech in their curriculum. However, we have seen numerous examples of EdTech implementations without a clear aim, vision, assessment and/or positive learning outcomes. This article will start with a definition of EdTech, delineating what it is not and what it is, and continue with a discussion of 'why' should EdTech be integrated, and 'how' to choose and to implement components of EdTech. Finally, we provide some take home messages and tips on successful integration of EdTech.

Keywords: barriers, digitalization, educational technology, educational tools, implementation, pedagogy, personalized learning.

INTRODUCTION

As educators, our main goal is to provide safe and efficient educational environments that will enhance learning in our students. While safe educational environments mostly depend on personal attitude and the teaching approach of the educator, efficient educational environments mostly benefit from integrating effective pedagogical elements. Over the past few decades, educators have been called upon to use novel education strategies for the latter, such as problem-based learning, team-based learning or inquiry-based learning, etc. With the flood of technological advancements that have pervaded every aspect of our daily life, there is also a push for implementation of educational technologies (EdTech) (technology integration or technology-enhanced learning): for example using massive online courses, creating videos, blending online instructions, etc. The current trends in educational research, and the fact that students are motivated by technology in the information age are the main driving factors of this new initiative. However, one cannot deny the role of commercial, political, and societal influences which force more and more educators to be involved in integrating EdTech. There are indeed many reasons and facilitator factors driving EdTech implementation, but also important barriers and drawbacks. In practice, educators are also faced with challenges in designing or integrating EdTech in a pedagogically meaningful way. Most of the time, educators attempt to effectively implement EdTech in their curriculum, but we do see numerous examples of EdTech implementations without a clear aim, vision, assessment and/

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or positive learning outcomes.

This article will start with a definition of EdTech and continue with a discussion of 'why' EdTech should be integrated and 'how' to choose and implement components of EdTech. Finally, we will close by providing some take home messages and tips on how to successfully integrate EdTEch.

WHAT EDTECH IS NOT?

EdTech is not just the new kid on the education trends block. It has been around for more than a decade and educators are trying to use it in various ways to support their instructional models.

EdTech is not something you can sprinkle over your courses just to make them look different or entertaining.

EdTech is not just fancy graphics and animation, etc. Enhanced visual content is only valuable if it supports educational intent.

EdTech is not a babysitter. It is not just a set of tasks that educators can give to their students to keep them busy. It is not about using fancy, expensive digital tools to replace paper and pencil.

EdTech is not a gimmick. It is a diverse range of valuable educational resources that enhance learning if used appropriately.

EdTech is not intended to be a replacement for educators. Although technology is a vehicle that can be used to drive educational success, without purposeful integration by competent educators, it can result in a loss of resources. Educators who coherently and successfully integrate EdTEch into the learning environment are (and will always be) at the heart of teaching and learning.

And finally, EdTech is not a magic wand that will solve all educational problems. In fact, use of EdTech does not in any way guarantee student or educator success. However, the art and science of knowing the efficient use of EdTech in the classroom is a magical asset for educators.

WHAT EDTECH IS?

EdTech is the use of digital technology to support and mediate educational activities (Cook and Ellaway 2015). One of the best definitions of EdTech came in 1980 from Goodyear & Retalis: 'all instructional events in which technology plays a significant role in making learning more effective, efficient or enjoyable' (Goodyear and Retalis 2010).

Today, EdTech has two main components: educational platforms (hardware) and educational materials (software). Examples for educational platforms are computers, smart phones, tablets, netbooks, mobile devices, projectors, 'smart' boards of different kinds, etc. while examples for educational materials may be apps, programs, blogs, wikis, forums,

websites, virtual classrooms, online documents, e-learning platforms, open online courses, discussion groups, etc. Both of these diverse sets of tools are used to engage learners in active and authentic learning.

Some examples of EdTech tools are shown in Fig. 1 (produced by Piktochart).

With EdTech, the educator is supplemented with a powerful tool that she/he can use inside the classroom (synchronously) as well as outside (asynchronously) to better support student learning (see also Table 1). Inside the classroom, educators can use EdTech integration to engage students in the content, to promote deeper learning, to keep track of learning in the classroom and to provide timely feedback by incorporating formative or cumulative assessments. Outside the classroom, texts, audios, images, animations, and streaming videos, etc. may be provided to students to deliver content and enhance deeper learning. Thus, students can remediate, practice, create and self-assess at their own pace based on their own needs. This makes EdTech a vital tool for personalized learning (anytime, anywhere through self-paced learning). However, using EdTEch also makes collaborative learning possible through various tools, such as online discussion groups, interactive platforms and online classroom environments (Cook and Ellaway 2015).

WHY SHOULD WE INTEGRATE EDTECH?

The answer to this question is not that modern technology is essential in teaching-learning, but the fact that if used appropriately, EdTech tools can potentially make the education process more meaningful, more engaging, more interesting, more personalized and more flexible.

Over the last decade, educational research has been focusing on the pros and cons of integrating EdTech, and many themes have been articulated for the observed benefits (Eady 2013; Chen 2019). Some of these are listed in Table 1.

However, these benefits are not always sufficient to encourage educators to take the necessary steps for implementation of EdTech. In most cases, the move is initiated by directors and administrators. Thus, a significant factor is executive enforcement (school policy). Nowadays, more and more universities are emphasizing EdTech integration in their curriculum and establishing university-wide e-learning platforms or learning management systems. Sometimes, positive EdTech integration experiences by colleagues inspires other educators to take the first step. And research has found that if there are expectations from students who have used EdTech integration in other classes, this is likely to inspire the educator to consider integrating technology in her/his course as well (Chen 2019). Also, teachers who had higher levels of computer skills, and who believed that the use of EdTech would benefit students in their future lives
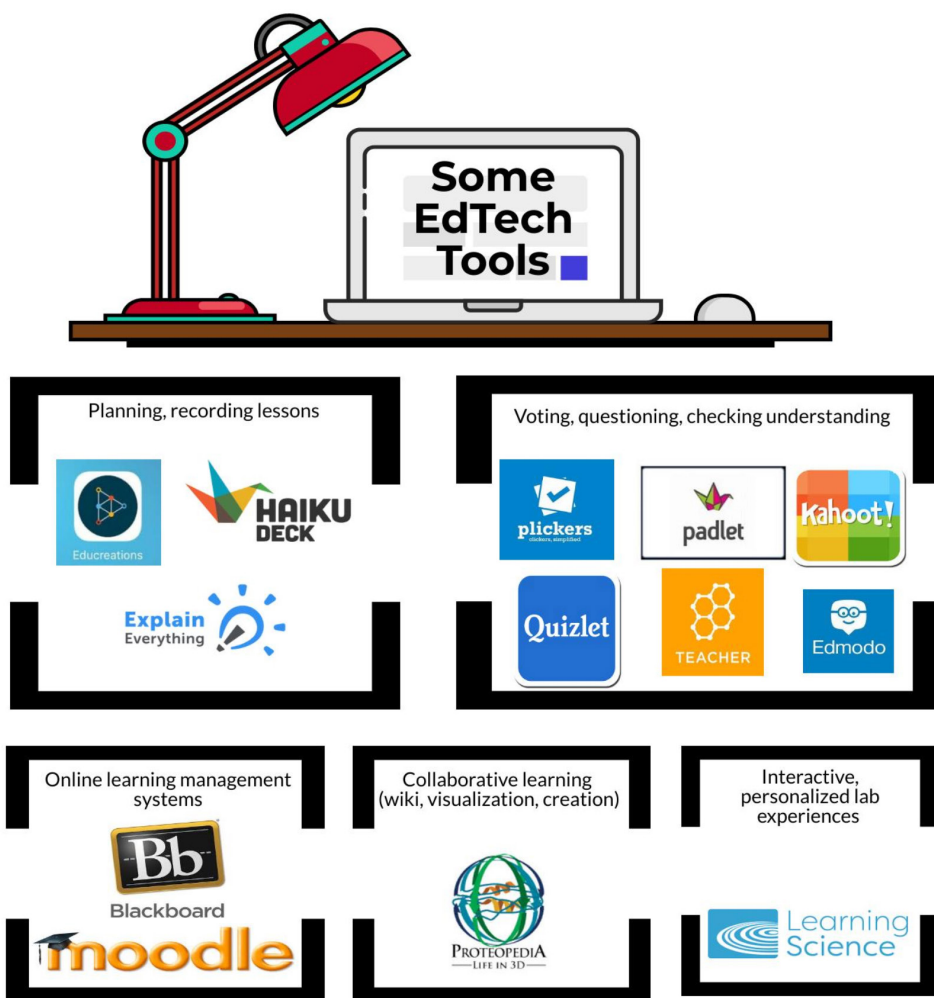
Fig. 1. Examples of some EdTech tools (produced by the author using Piktochart).

were more likely to consider purposeful implementation of EdTech into the classroom (Willis 2018).

WHY DO WE AVOID IT?

In some cases, educator's lack of motivation due to limited or complete lack of institutional support may be the sole reason for not implementing EdTech, but in most of the cases multiple variables were found to affect EdTech integration (Chen 2019). Ertmer initially classified these variables as first- (extrinsic, incremental, institutional) and second-order (intrinsic, fundamental, personal) barriers (Ertmer 1999). A list of these barriers, revised with data from recent research has been compiled in Table 2 (Ertmer 1999; Eady

Table 1. Benefits of integrating EdTech for teaching-learning.

- Supplements traditional teaching (as a way to introduce students to a topic, as a part of a teacher lecture or demonstration, as a stimulus to group or whole-class discussion, as a way to promote flipped learning, as a review or extension activity)
- Enhances student motivation and engagement
- Promotes higher order thinking (through creativity exercises)
- Encourages immediate educator–student interactions and feedback
- Provides students with instruction and practice through quality digital content
- Helps track the learning process (adjust teaching strategies according to students' responses at any time in the classroom)
- Creates opportunities for an individualized path and pace for students (through remediation, practice, etc.)
- Assists in record keeping
- Advances professional learning objectives (subject specific skills like data analysis and bioinformatics) according to varying student backgrounds

Table 2. First- and second-order barriers affecting EdTech integration.

First-order barriers	Second-order barriers
✓ Lack of access to computers and software ✓ Insufficient time to plan instruction (EdTech integration to instruction is more time-consuming than creating traditional content) ✓ Inadequate technical & administrative support ✓ Stakeholder demands ✓ Presence of competing work demands	✓ Beliefs and attitudes about teaching ✓ Beliefs about computers ✓ Technological competence ✓ Established classroom practices ✓ Subject competence ✓ Technological pedagogical content knowledge (TPACK) experience ✓ Unwillingness to change

and Lockyer 2013; Chen 2019; Youm 2019).

Among these, maybe the most interesting variable is the TPACK experience. In general, it is easy to understand the challenges that inevitable technical problems (e.g. students may not be able to download apps, open files, or log in to Wi-Fi) can create in the classroom. Naturally, educators feel the need for competence in managing these technical problems that would affect participation. However, TCPK knowledge indicates that technological competence alone is not enough. Unless the educator feels at ease with the pedagogical knowledge (i.e. "I am experienced and familiar with common student understandings and misconceptions") and content knowledge (i.e. "I have mastered my subject and have comprehensive content knowledge") she/he will not be able to comfortably say "I can teach lessons that appropriately combine basic science content, EdTech and teaching approaches" (Youm 2019; Chen 2019).

HOW TO CHOOSE?

EdTech comprises a variety of tools & resources, and the area is evolving exponentially. So, educators should not start by using new products on the market but instead try to decide which issues need to be solved or improved in their teaching. As with every educational tool, it is of utmost importance to first identify the needs; to define which learning problems or educational strategic issues the educator would like to solve or improve. When focusing on these questions, one should be clear concerning the realities (abilities and experiences) of the students', together with their needs and preferences (Technology in the Classroom: Insights for Optimization Document).

In order for learning to occur, tools or resources need to be chosen or designed using sound educational principles. One of these is the cognitive load theory, developed by John Sweller (Sweller, 1988). This theory suggests that the load on our working memory should be reduced to enable one to construct schemes for long-term learning. Accordingly, specific recommendations relative to the choice of appropriate EdTech may be suggested as:

1. Clearly identifying the complexity of the learning materials and the experience of the learner
2. Increase working memory capacity by using auditory as well as visual information
3. Focus on information and activities directly related to schema construction

Some questions to be asked when evaluating which tool to choose may be:

- Does it fulfill a learning need?
- What is the pedagogical approach used?
- Is it meaningful? Do the elements support the educational intent?
- Is it engaging (intelligent interactivity)? Is it constructive? Is it authentic?
- Does it create opportunities for students to work together in learning?
- Is it user-friendly? Are the key screens well-designed, and can students move from one activity to another?
- Does it combine two or more modes (such as visual, audio or spatial)?
- Does the app or software provide direct instruction, inquiry-based (team-based, project-based etc.) learning experiences?
- Does it fit into the infrastructure of the classroom or educational environment?
- Is it game-based learning?
- Does it provide feedback loops for the student and the educator?
- Does it customize learning for students? Are there elements of personalization? Does it foster personalized learning?
- Does it provide diagnostic, formative and summative assessments?
- Is content hosted on local servers, on the cloud or by a third party?

After needs analysis and careful evaluation of the characteristics of EdTech, it is time to organize the goals of the curriculum and technology into a coordinated, harmonious whole.

HOW DO WE BEGIN IMPLEMENTATION?

There is clearly a need for purposeful and effective implementation of EdTech since research has shown that merely integrating technologies into established systems and processes is ineffective. Instead, EdTech can be applied to enable new systems and processes that better meet the needs of the students. The key in this application is pedagogically-based implementation of EdTech rather than technology driving or mandating education.

'Leveraging technology successfully will depend on the student, the educator (educator's intentional instructional approach), as well as the existence of systemic support in the school' (Technology in the Classroom: Insights for Optimization Document).

When implementing EdTech, it is important that the educator allows enough time for usability testing, for preparing and practicing EdTech. Meanwhile, the purpose and methods of integration should be clearly communicated with the students. Once implemented, it is time for the educator to observe the implementation, to evaluate students' experience & learning outcomes and the contribution of EdTech to these processes. Listening to student feedback is valuable as it helps to figure out if EdTech is working in that particular educational environment.

Integrating EdTech means having new routines, teaching new skills and strategies, and being patient while students adjust. Thus, educators willing to use EdTech are expected to be flexible and occasionally may be uncomfortable and uncertain. Having a backup plan and willing to adjust if something is not working are also important features of successful educators.

It is valuable that educators integrating EdTech collaborate, not only with their colleagues but also with educators across the country, and even around the globe. Staying up-to-date with new research and technology in the education field will help educators to use EdTech in the most efficient way 'to prepare their students for the future they will inherit' (Ertmer 1999).

TAKE HOME MESSAGES:

EdTech has the potential to make learning personalized, interactive and interesting.

Meaningful use of EdTech is required in order to allow for achievement of important educational goals, and is a ne-cessity for all educators who want to maximize their teaching potential.

Implementation of EdTech requires completion of a needs analysis, choosing the appropriate EdTech tool and employing a pedagogical approach for integration, followed by authentic assessment of learning processes and outcomes, all while never losing sight of the educational objectives.

Institutes should offer education and training through multiple channels to improve knowledge with respect to EdTech. Encouraging educators to embrace pedagogically-based implementation of EdTech should be one of the main aims of directors.

Educational research should also focus on development and report results of a standard, comprehensive evaluation approach concerning the use of EdTech in the classroom.

REFERENCES

Chen HJ, Liao LL, Chang YC, Hung CC and Chang LC. 2019. Factors Influencing Technology Integration in the Curriculum for Taiwanese Health Profession Educators: A Mixed-Methods Study. International Journal of Environmental Research and Public Health 6(14):2602. DOI: 10.3390/ijerph16142602.

Cook DA, Ellaway RH. 2015. Evaluating technology-enhanced learning: A comprehensive framework. Medical Teacher. 37(10):961-970.

Eady MJ, Lockyer L. 2013. 'Tools for learning: technology and teaching strategies', Learning to Teach in the Primary School, Queensland University of Technology, Australia, 71.

Ertmer PA. 1999. Addressing first- and second-order barriers to change: Strategies for technology integration. Educational Technology Research and Development. 47(4):47–61.

Goodyear P, Retalis S. 2010. Learning, technology and design. In: Goodyear P, Retalis S, editors. Technology-enhanced learning: Design patterns and pattern languages. Rotterdam (the Netherlands): Sense Publishers. p. 1–28.

Sweller J. 1988. Cognitive load during problem solving: Effects on learning, Cognitive Science. 12(2):257–285.

Technology in the Classroom: Insights for Optimization (Accessed on Sept. 12, 2019). https://www.edelements.com/hubfs/Technology%20Pillar/Technology-in-the-Classroom-Guide.pdf?hsCtaTracking=ebb78c43-6dc9-4483-8ac3-4d212edf0756%7C3a8a2f44-4c24-4734-87b9-91c139724f31.

Willis RL, Lynch D, Fradale P, Yeigh T. 2018. Influences on purposeful implementation of ICT into the classroom: An exploratory study of K-12 teachers. Education and Information Technologies. 24(1):63–77.

Youm J, Corral J. 2019. Technological Pedagogical and Content Knowledge Among Medical Educators: What Is Our Readiness to Teach With Technology? Academic Medicine. Jul 30. DOI: 10.1097/ACM.0000000000002912. [Epub ahead of print].