Towards adoption of technology-enhanced learning: understanding its benefits and limitations

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***Abstract*—Technology is embedded in all walks of people's lives, including the diverse forms and types of contemporary education. With technology becoming increasingly popular in a variety of contexts, scholars have developed models that allow to explore how technology-enhanced learning (TEL) is adopted. One of the key prerequisites for TEL adoption is its acceptance by the involved users. TEL acceptance can be hindered if technology is implemented without properly exploring its benefits and limitations. They should be also well understood by policy makers who offer top-down guidelines to employ TEL as a means of modernizing educational systems across the globe. Therefore, the present paper highlights the most prominent topics of the debates on implementing TEL when it comes to the two opposite ends of the spectrum, namely technology supporters on the one end and critics on the other.**

Keywords—Technology-enhanced learning, TEL, technology adoption

I. INTRODUCTION

Contemporary teaching and learning, regardless of its different forms (i.e. formal, informal, informal), can no longer be imagined without any use of technology. Technology, especially if it has been developed for educational purposes, is often seen as a means to promote and enable the modernization of educational systems. Both public and scientific discourse have a lot of different opinions about technological interventions in education. Those individuals who oppose using technology for educational purposes and their opponents, individuals who are in favor of technology, are often sarcastically labelled as "technophobes" [1] on the one end of the spectrum and "technoromantics" [2] or "technology enthusiasts" [1] on the other. The representatives of the two stances try to empirically ground their stance, which is achieved by conducting research in the area that is referred to as technology-enhanced learning (TEL). Over the past 50 years, research in the field has been increasingly conducted by representatives of educational sciences, informatics, and psychology.

There are many different terms in scientific literature for defining TEL, which at a first glance seem to be synonymous. However, there is a considerable discrepancy between their operationalization and realization. In scientific discourse, terms such as e-learning, m-learning, technology-based learning, computer-based learning, game-based learning, etc. are still popular and visible [3-5]. Nevertheless, there is a growing number of sources claiming that this area is best reflected by the term "technology-enhanced learning". Although it is not clearly defined in the scientific literature, it could be explained as a form of learning adapted to (1) be accessed in a number of ways by using technology, (2) organizing teaching/learning processes, (3) communicating, (4) collaborating, (5) making the learning process more effective, and (6) performing other type of learning-related tasks [5].

When criticizing the components of the term "technology-enhanced learning" and the lack of their clear operationalization in scientific literature, Bayne [4] emphasizes that the English version of the term does not reflect the word "teach" because technology is primarily used for teaching, not learning. As the author of the present paper supports the latter observation, after providing a brief overview of TEL adoption models, the paper further explores the negative and positive aspects of technology-enhanced teaching /learning by focusing on both, the educators and the learners.

II. ADOPTION OF TECHNOLOGICAL INNOVATIONS IN EDUCATION

As was previously indicated, with the hope to modernize education and increase students' learning outcomes, instructors across the globe implement technology. In many cases, when implementing technology for educational purposes, they engage in educational borrowing, which can be explained as a deliberate adoption of various learning objects (e.g. multimodal instructional content, curriculum, teaching/learning methods, Information and Communication Technology, etc.) from one context to [6]. Adoption of novel technology (or innovation) is a complex process that takes a long time. As can be seen in Fig. 1, there are different stages involved in the adoption process, and some innovations do not become mainstream. To study the process of innovation adoption, Rogers [7] also proposed a Diffusion of Innovation Model (see Fig. 2), which is still widely applied across different disciplines. It can be suggested that the initial stages of implementation are essential to the successful adoption of, in this case, digital learning objects.

It can be suggested that the key component that might lead to adoption of the aforementioned innovations is technology acceptance. One of the most commonly used models for measuring it is the Technology Acceptance Model (TAM), which was presented by Davis in the 1980s [8]. Research shows that, despite the widespread use of technology, even younger educators are reluctant to adopt and deploy technology, they often feel anxiety, and are skeptical about

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the educational potential of technology. TAM research reveals similar trends in the adoption of learner technologies. Other additional factors, such as culture and foreign language [9-10] also make the adoption and implementation of technology particularly difficult, thus their lifecycle becomes brief and their true educational potential remains undisclosed. In order to solve the aforementioned issues and to encourage more adoption of TEL, it is vital to better understand its benefits and limitations. The remaining of the paper discusses the main tendencies that emerge in scholarly debate over the former or the latter.

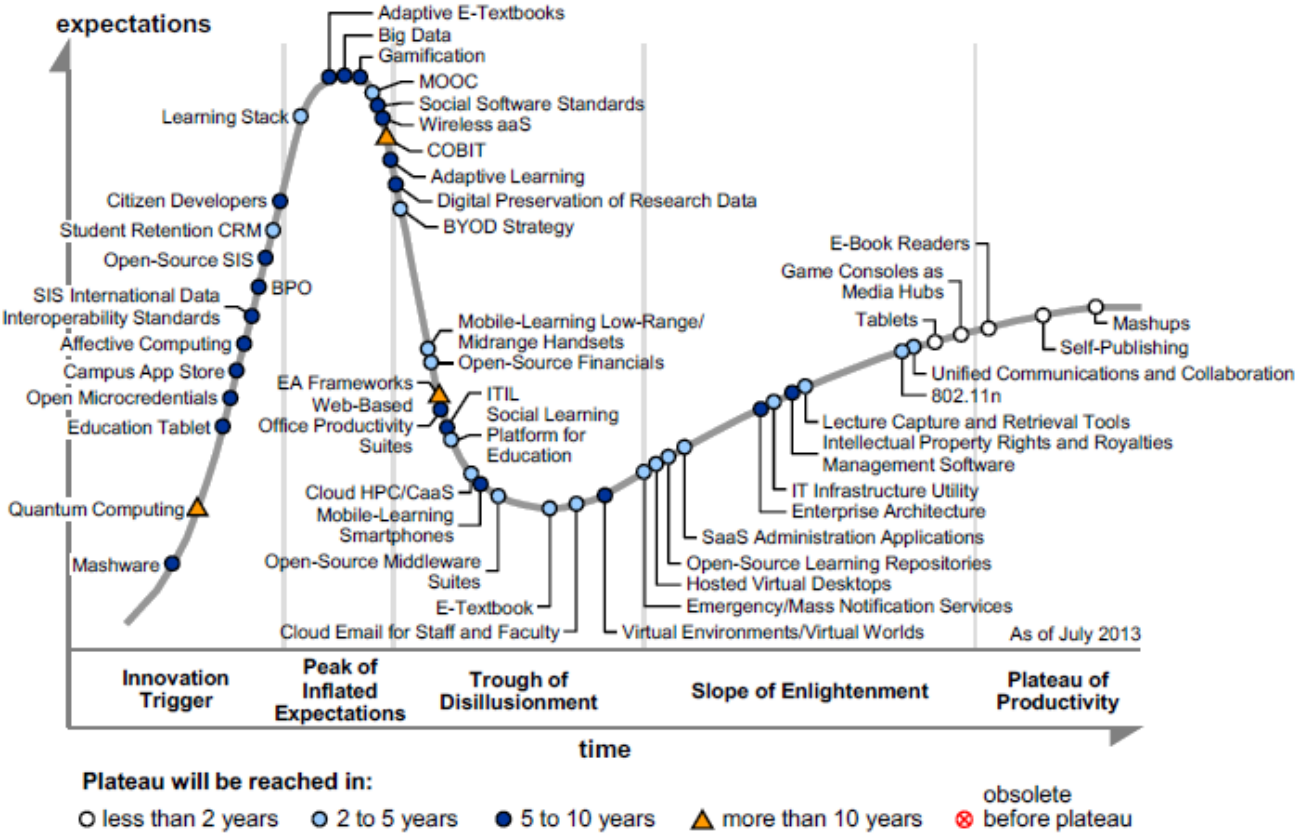

Fig.1. Gartner's Hype Cycle of Technology in Education [11]

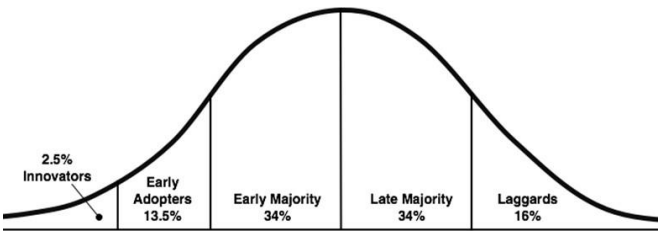

Fig. 2. Roger's Diffusion of Innovations Model [7]

III. LIMITATIONS OF TEL AS DISCUSSED IN SCIENTIFIC DISCOURSE

Although technology-enhanced teaching/learning in its definition suggests a number of benefits, in scientific discourse, there is considerable criticism towards it. Kohn and Hoeffsteder [12] illustrate one of the most common points of criticism when it comes to technology used in education by employing a metaphor of "the caravan effect". They suggest that the travelers (i.e. technology enthusiasts) stop for a short while (i.e., new technology), but travel quickly to find a new source. Other authors suggest that scholars might be trying to solve problems by using technology when technology itself is the root cause of the problems in the first place [13]. There is a lot of criticism for the past debates and studies on technology-enhanced teaching/learning because of their previous focus on technology over the student and his/her learning outcomes. It is more and more emphasized that technology should be a means to achieve the goal, not the goal itself [13]. Other authors note that the breakthrough of technology development is controlled by computer scientists and business needs. Therefore, introducing such technologies into the learning process, especially if they are unexplored by educational scientists, should be more carefully assessed [14].

New technologies that appear in educational contexts are often called disruptive [15]. This is primarily because they become innovations that present challenges for all those who are involved in the teaching/learning process. Despite their innovativeness, disruptive technologies often need to be adapted to specific contexts and needs [6, 16] . Such changes, respectively, require changes from the educators, learners or educational institutions as well.

Many a time, the decision to introduce new technologies in the teaching/learning process is brought top-down, for example, through educational policy decisions or guidelines. In practice, however, such pressure often does not produce any results [17]. Developing and introducing new technologies to educational settings is often costly [17], requires a lot of time and other resources from the individuals

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who implement them [18].

There is a global trend that the generation of educators, especially university teachers, is aging [19]. It can be assumed that many of them belong to the generation X, which, unlike the generation Y and Z (for the alternative names of the generations, see Fig. 3 below), does not have such good digital literacy skills. It can be argued that such educators also lack the ability to design contemporary courses that include technological interventions, as research overviews suggest that technology is very often used as a new medium to convey the same content [20]. For these reasons, educators without appropriate training have to obtain new qualifications and training, which is highly undesired because it also wastes a lot of time and financial

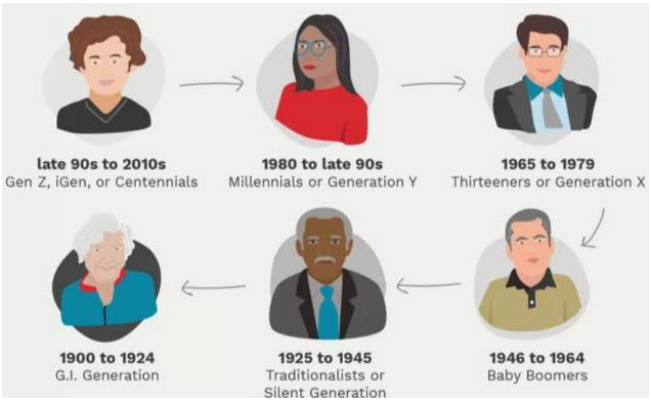

Fig. 3. Different titles of generations (Rosenberg, 2018)

resources. Learners are also reluctant to take on additional independent work. Technology can be implemented to successfully work under the learning paradigm and to direct the whole process at the learner, give him/her a lot of autonomy in deciding what, when, and how to learn. However, previous research reveals that learners are not yet fully prepared for self-directed learning through the use of technology [21].

Other challenges related to technology-enhanced teaching/learning can be observed as well. Due to the complexity of the field of technology-enhanced teaching/learning research, a large number of studies are fragmented, explore only certain aspects from the perspective of educational sciences, informatics or psychology. Another shortcoming is that these studies are often carried out in a very specific cultural context with a small, unrepresentative sample, and therefore the reported statistically significantresults should be interpreted with caution [11]. It is also worth noting that there is a lack of longitudinal research that reveals the true potential of technology-enhanced learning, maintaining knowledge and skills compared to the traditional learning methods. Interdisciplinary research that acknowledges and overcomes the aforementioned limitations could lead to more accurate results and deeper understanding of the phenomenon.

IV. BENEFITS OF TEL AS DISCUSSED IN SCIENTIFIC DISCOURSE

Educational sciences distinguish between three paradigms, namely, teaching (also, instruction), interaction, and learning [23]. In the first paradigm, all decisions related to learning content, methods, and other processes are decided upon by the educator. In the second paradigm, there is a closer link between the educator and the learner, and the latter is given more freedom to choose how to learn. The third paradigm gives the learner the most flexibility as s/he has the most freedom, can choose both the learning content and the methods; the role of the educator changes completely, s/he becomes the facilitator, mentor, and consultant of the learning process. Scholarly output of educational sciences emphasizes the need to move to the learning paradigm. This can be achieved with the help of technology.

Despite the criticism and skepticism surrounding the technology-enhanced learning potential, many scholars or education policy makers support such interventions in educational settings. Scientific literature, based on both empirical research and theoretical discussion, identifies a number of technological advantages for both educators and learners. For example, the introduction of new technologies is beneficial to educators' performance. Laurillard et al. [17] observes that new technologies extend the practice of educators and make them more professional.

Technology-enhanced teaching/learning can use a variety of teaching/learning methods and strategies, access multimodal content, or deliver content in an attractive, convenient, easy, and free-of-charge manner. There is a lot of research that reveals the benefits of blended or distance learning [24]. Universities and businesses are also developing Massive Open Online Courses (MOOCs) that are attractive because they are usually free, flexible in terms of time and space, inclusive, as well as suitable for both traditional and non-traditional students. It should be noted that even the most popular MOOCs (e.g. Fig. 4) suffer from high student dropout rates, but MOOC enthusiasts (especially researchers in open universities) continue to conduct research, improve the design of MOOCs to address this challenge. It can be anticipated that the advances in research will improve the performance and importance of MOOCs in life-long learning practices.

Fig. 4. Some of the most popular MOOCs [25]

It is also important to mention that TEL allows a learner to study in relatively authentic conditions, making learning more meaningful. For example, one of the most important aspects of learning a foreign language successfully is authenticity. Learners do not always have the opportunity to travel to the country where the language has the status of a state language, but with the help of technology, virtual simulations, tandems, access to corpora, etc. achieving authenticity is possible. TEL is well-suited to STEAM subjects and various fields of medicine, in which learners, through various simulations or virtual experiments, are enabled to understand and see intricate processes and to also

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avoid the risk to their own or others' lives. There is also a number of virtual reality tools through which the learners enhance, for example, their professional skills, by performing certain tasks physically [26].

Meaningful learning also takes place during personalized (as well as individualized) learning or collaborative learning. In modern education, neither one nor the other can be imagined without technology [11, 27]. A review of scientific literature reveals that learning which is personalized via technology support, allows the learner to control the pace of learning and track its progress through various systems that adapt to the learner's needs and progress, encourage to solve challenges, and provide feedback quickly [11]. The following benefits of collaborative TEL are also highlighted: better learning, longer retention of acquired knowledge, training of critical thinking, more accurate and creative problem solving, motivation, transfer of learning to other situations, etc. [28].

V. CONCLUSION

Changes in education are inseparable from socio-economic changes in society, driven by technological progress [29]. It can be said that any teaching/learning contexts are inseparable from Information and Communication Technology. There is a lot of criticism when it comes to technology-enhanced teaching/learning in both scientific and public discourse, which encourages all interested parties to reflect on how and why technologies are used for educational purposes. Past errors or limitations of research indicate that it is crucial to appropriately plan technological interventions, to reflect on all important variables, educational factors and goals, and only then to implement technology; more importantly, not to use technology just for the sake of using technology. Only then will it be possible to guarantee what Dror [30] calls qualitative and quantitative changes in teaching/learning.

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