

Education

A Re-examination of the Value of Educational Technology

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Technological advances in human history influenced the evolution of education to varying degrees. The widespread application of information technology in education has resulted in certain changes in educational materials, methods, environments, and research patterns. However, there is growing doubt about the transformative power of educational technology to change education for the better. This article is a review of the overall effect of emerging technologies on educational outcomes, with a focus on examining the unwelcome consequences of the use of educational technology, in the hope of providing implications for further research and practice in the integration of technology and education.

Keywords: Education; Educational Technology; Information Technology

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HISTORICALLY, the development of education, a unique activity of human society, has been closely related to technological advancement (Liu, 2006). In the information age, numerous education researchers and educators have worked to apply emerging technologies to education, such as the computer, the internet, cloud computing, big data, and artificial intelligence (AI) (Yi, 2017). Generally, educational technology is recognized as the process of integrating technology into education in a positive manner that promotes a more diverse, efficient learning environment. It is believed that educational technology has the potential to help people realize higher-order educational objectives. With this belief, there has been a growing expectation that educational technology will bring fundamental changes to education (Chen & Qi, 2021). However, new technologies are often accompanied by unrealistic hype and promises. With the passage of time, queries about the value of

educational technology have been increasing.

The Unmet Expectations of Educational Technology

Amid the recent waves of educational reform across the globe, most countries have significantly increased investment in educational infrastructure, with the heavy application of information technology to education. According to the data on digital infrastructure of Chinese educational institutions released by the Ministry of Education of China (2023), as of 2022, all primary and secondary schools (including teaching sites) in China had internet connectivity; more than 75% of them were equipped with wireless networks; 99.5% had multimedia classrooms, which amount to 4 million in aggregate; and in-school computer terminals for the use of teachers and students exceeded 28 million. Hence, a basic digital education ecology that integrates

offline multimedia teaching and online instruction based on pervasive network coverage has formed in China. The application of information technology in education renders educational resources more accessible to more people by changing the patterns of information acquisition and communication (Jian et al., 2021).

For both developed and developing countries, the purpose of developing digital infrastructure and educational technology is to substantively enhance their quality of education. Nevertheless, technology has, so far, failed to exhibit a significantly transformative power to change education for the better (Chen & Qi, 2021). The rethinking of digital education in Western nations began in the early 21st century. In 2009, the U.S. Department of Education sponsored a survey on the impact of technology on the quality of education, with a random sample of 21,000 secondary school students. The survey results revealed that there was no significant difference in reading, mathematics, and science performance between these students and those of 30 years ago, when computers were unavailable in schools or homes. The report was staggering and sensational as it evidenced that the huge input in digital education did not necessarily lead to increases in educational outcomes (Wang, 2015). Yong Zhao, a member of the National Academy of Education in the U.S., made the point that, globally, education did not make much progress and might even have regressed in recent decades as indicated by student test results, if test results can be used as measurements for educational standards (Zhao et al., 2024). As to the question of “why computers have brought changes to almost all sectors but have surprisingly little influence on school education” raised by the late Steve Jobs, the former U.S. Secretary of Education Arne Duncan’s statement that there has been no structural transformation in education appears a plausible explanation (Isaacson, 2012).

The Incompatibility between Information Technology and the Current Education System

The basic structure of the currently prevalent education paradigm originates from the Prussian education system in the 19th century, characterized by compulsory education, governmental supervision, and standard curricula. This education paradigm is based on the following hypotheses: Age and grade are the primary factors in determining the student’s learning capacity and needs; prescribed teaching materials are consistent with the learner’s future needs and interests; uniform tests and assessments are effective in measuring the student’s learning progress and outcomes; the definite education machinery can define the learning paths and lifelong development trajectory for the learner (Zhao et al., 2024). Such an education system did serve the needs of social and economic development in the initial stage. Yet, as a result of the advances in science and technology, particularly the advent of information technology, its limitations become increasingly pronounced (Xu, 2022).

In the information age, the proliferation of information and accelerated updating of knowledge necessitate more diverse, flexible education modalities. In this context, the existing education system has, to some extent, become a constraint to the individual development and possibility of individual self-creation by imposing on the learners unified instructional methods, curricula,

and assessments as well as a unitary academic standard (Xiao & Shang, 2019). Also, the fresh teaching and learning experiences elicited by new technologies awaken the education world to the limitations of the current education paradigm (Zhao et al., 2024). For example, with the application of AI in education, teachers and students are increasing their use of generative AI in carrying out education and research activities, such as assignment completion, assignment marking, lesson preparation, classroom instruction, paper writing, recommendation letter writing, and more. In addition, generative AI has the potential to integrate knowledge from multiple disciplines and generate recommendations for the learner, making their explorations in new areas much easier.

The Negative Consequences of Educational Technology and Causes

It appears that we are living in a highly technology-dependent era. Yet, in the field of education, technological applications have not instigated any substantive changes in fundamental educational elements like interpersonal relationships and cognitive patterns, even though they have made some difference to the way we access learning resources, such as seeking out information through search engines, online learning websites, artificial intelligence matching, etc., and to the way information is presented, as now information can take more diverse forms like the table, graphic, video, animation, classified data, and visualized data (Zheng, 2021). Worse still, overfocus on educational technology may bring about a variety of “side effects” due to our disregard for the essence of education.

Information Anxiety Induced by Digital Devices

Digital tools are now being heavily used in educational settings. While they significantly enrich teaching materials, they overload the student with an inordinate amount of information in a limited period of time. Nevertheless, the human capacity to process information is relatively stable; being inundated with excessive information can only cause anxiety in learners. The nature of education is about teaching students the right things rather than a lot of unnecessary stuff because the time for learning is finite, and completing the learning process as promptly as possible has been a prerequisite for human existence (Wang, 2023).

Increased Burdens Caused by Virtual Education Spaces

Information technology has substantially expanded the temporal and spatial scopes of education, allowing the ubiquitous enactment of teaching and learning. While the increased flexibility of educational environments helps enhance efficiency, it also poses additional burdens to the teachers and students as their roles can extend beyond the campus to anywhere else. Evidently, the use of technology can hardly make their life easier; instead, it can be potentially hazardous to their physical and mental health. Furthermore, the ongoing iteration and updating of educational technology make the manipulation of digital devices increasingly complicated, leading to the teachers being entangled in the endless process of acquiring new knowledge about technological application (Zhang, 2016).

Suppressed Teacher-Student Communication Due to Machine Use

The introduction of human-machine interaction has recreated the traditional education ecosystem, and a portion of instructors' duties has been moved to machines. Although the use of machines can help address the shortages of teaching forces, the teacher's role in education is irreplaceable. Teacher-student face-to-face communication remains the most effective avenue for instruction. Also, it is of vital significance for student social development, as the teacher is not only responsible for imparting knowledge to students, which may be partially delegated to machines, but also for delivering moral character and value education. The potential hazards of reduced teacher-student interaction are far more severe in those regions that have the issue of teacher shortages and have a heavier dependence on technology to make up for the gap (Li et al., 2024).

Shallow Learning as a Result of Internet Dependence

Overuse of the internet is detrimental to the concentration and reasoning ability of the student. The internet encourages the rapid, fragmentary reading of small bits of information from many sources as opposed to traditional reading and writing practices that focus the learner's attention and promote deep and creative thought. While becoming more adept at scanning and skimming, students are losing their capacity for concentration and contemplation (Carr, 2020). Furthermore, with easy access to relevant information provided by the internet, the student can come up with the answers to the questions from their schoolwork without substantive efforts. This deprives them of the experience of overcoming challenges, hampering the development of academic resilience in them. In addition, the entertaining feature of the internet has the potential to lead the learner to a simplistic, illogical, and emotional way of thinking.

Ethical Risks of Digital Education

Nowadays, the adoption of technology in instruction has become a major indicator for the evaluation of educational quality. Yet, the negative effects of technology abuse on conduct and morality in students have been ignored. For instance, the question-search application was initially developed to assist students in getting references for their answers. Over time, its adverse effect became prominent as it could be used by the student to obtain existing answers to save any real efforts. Applications like this instigate dishonest learning behavior in students, contributing to the increased prevalence of cheating in educational settings.

The primary cause of these issues resides with the lack of realization that educational technology and education carry different ethics. Educational technology, like any other form of technology, follows the principle of efficiency optimization (Tian et al., 2023), while education has higher-order pursuits, including promoting the all-round development of individuals. How to best serve the development needs of the educatees should ever be the first consideration in educational practices, including digital education. The technology-first approach in digital education can only result in the blind deployment of emerging technologies and bring disruptions and chaos to nor-

mal teaching and learning (Li et al., 2024). In the meantime, the longstanding tendency of a one-size-fits-all approach to educational reform exacerbates the negative consequences of the technological application in education. Digital technologies are not a panacea for all existing problems in current education. Their introduction and adoption should vary by discipline, education level, and education setting (Liu & Li, 2024).

What kind of education and technology are needed in the Information Age?

Educational philosophy is of paramount significance for addressing issues arising in education. It decides what technological tools to use, but not vice versa (Ren, 2010). According to Sankey (2020), it is the pedagogy that we need to consider first before we decide on the technology that we are going to use to enact our teaching. Nevertheless, amid the current proliferation of applications of educational technology, the more common practice is to first decide on a form of technology and then try to adapt the pedagogical approach to suit the chosen technological instrument. This is an illegitimate order of priorities. Only those technological applications that are well grounded in appropriate teaching or learning theories have the potential to instigate instructional innovation.

Due to the increasing influence of technology in the sector of education, the following moves are imperative: (i) Renew educational goals. AI is going to excel in certain manual jobs and compete with humans intellectually as well. To react to the long-term challenges posed by AI, education should adapt its talent development goals to the needs of future society, focusing on fostering the students' key competencies and essential qualities for future social integration and lifelong development. (ii) Reconstruct instructional content. Rote memorization should largely give way to the cultivation of innovation ability through practical education. (iii) Innovate teaching modalities. The application of technology like AI can solve the contradiction between large-scale education and individualized teaching while also improving educational equity and enhancing the overall quality of education. (iv) Modify the role of the teacher. The replacement of time-consuming, repeated instructional activities by AI applications will enable the teacher to devote more time and energy to more sophisticated, creative, and artistic interaction with students. (v) Reform educational management. Management in the information age requires optimized sharing of data, reduced systemic barriers, and open access to information. To boost the effectiveness of technological applications in improving the efficiency and precision of educational management, more explorations of how to integrate educational data, enhance data governance standards, and heighten data security are necessitated.

Education development in the new era is primarily responsible for three objectives: to fully leverage all available technologies and resources to provide high-quality education to all students; to ensure they receive the training that respects their natural talent and individuality; and to circumvent the reproduction of social inequality by delivering up-to-par basic education to all populations across the world. To this end, it is imperative to:

Harness Educational Technology to Reshape Educational

Ecology. In this era of accelerated advancement of technology, it is necessary to rethink the process of the mental development of humans. We need an education ecology that no longer pursues the standardization of curriculum but seeks to cultivate plural talents to cater to the diverse needs of society and support personalizable education by pooling global educational resources and experiences (Zhao, 2018a, 2018b). The development of information technologies like AI makes such an ecology practicable, which enables students to learn from or collaborate with anybody in any place in the world, as well as remotely helping others with their problems (Zhu & Hu, 2022).

Utilize Educational Technology to Reconstruct the Focuses of Education: The advent of generative AI forces humans to contemplate their roles in a society where AI permeates and re-examine their learning methods (Wang, 2018). The cultivation of digitally capable citizens has become an overarching goal for future education. The training of higher-order abilities and skills, such as computational thinking, design ability, innovation mentality, problem-solving, and collaboration, is to be interwoven into the design of learning activities with the help of educational technology. Future learning activities need to be more student-centered, with an exceptional emphasis on interdisciplinary, experiential, and self-motivated study (Wang, 2023).

Make Full Use of Educational Technology to Transform the Educational Evaluation System: As a result of the leap forward in information technology, the collection, transmission, and storage of educational data have become much easier, and

the processing, mining, and application of data have increasingly advanced. In this context, there is a need for a transition from teaching decision-making based on a single set of data and subjective perceptions to evidence-based decision-making supported by multi-dimensional and multimodal data. This warrants a reform of the educational evaluation system to adapt the learning objectives, tasks, and assessments to better cater to the training of the next generation. The consensus among learning sciences researchers is that a comprehensive assessment approach should be adopted to provide a variety of evidence to support educational decision-making and that multiple measures enhance the validity and fairness of evaluation by giving students various ways and opportunities to demonstrate their competence (Pellegrino, 2014).

Conclusion

Technology itself does not necessarily catalyze fundamental improvements to educational practice. Educational technology should be treated as a means rather than an end in educational development (Ely, 1995). The focus needs to be on the interaction between education and technology, a process of discovering and clarifying challenges in current educational practices and employing the capabilities of technology to address them. Technology is expected to bring the desired changes to education; yet what technology to use and how to apply it to educational reforms are issues warranting constant rethinking. ■

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