Technological teaching and innovation: perspectives for the near future

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Abstract: The information age requires different forms of education and teaching than other past eras. These requirements can be seen through various means, such as job and job advertisements, the composition of scientific production teams, and collective representations. Some take knowledge forms, such as creating projective models; others are in the operational field, such as handling drones. What characterizes the current stage of the information age is the intimacy with technologies and their creative process. This directly impacts teacher training because it is part of their professional mission, and technology is not yet one of the central focuses of their training. Concerned about the implications of this reality, EDUCITEC proposed the "Technological Teaching and Innovation Dossier: Perspectives for the Near Future" to the scientific community. In this sense, this brief communication aims to present the theme and findings of the selected studies briefly.

Keywords: technological teaching, innovation, future perspectives, teacher training.

Resumen: La era de la información requiere formas de educación y enseñanza diferentes a las de otras épocas pasadas. Estos requisitos pueden verse a través de diversos medios, como anuncios de empleo y empleo, composición de equipos de producción científica y representaciones colectivas, entre otros. Algunos toman formas de conocimiento, como saber crear modelos proyectivos, otros son en el campo operativo, como el manejo de drones. Lo que caracteriza la etapa actual de la era de la información es la intimidad con las tecnologías y su proceso creativo. Y esto tiene un impacto directo en la formación docente porque forma parte de su misión profesional y porque la tecnología aún no es uno de los ejes centrales de su formación. Preocupado por las implicaciones de esta realidad, EDUCITEC propuso a la comunidad científica el "Dossier de Docencia e Innovación Tecnológica: Perspectivas para el Futuro Próximo". En este sentido, esta breve comunicación tiene como objetivo presentar de manera sucinta la temática y los hallazgos de los estudios seleccionados.

Palabras clave: enseñanza tecnológica; innovación; perspectivas futuras; formación docente..

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Educación tecnológica e innovación: perspectivas para el futuro próximo

Resumen

La era de la información requiere formas de educación y enseñanza diferentes a las de otras épocas pasadas. Estos requisitos pueden verse a través de diversos medios, como anuncios de empleo y empleo, composición de equipos de producción científica y representaciones colectivas, entre otros. Algunos toman formas de conocimiento, como saber crear modelos proyectivos, otros son en el campo operativo, como el manejo de drones. Lo que caracteriza la etapa actual de la era de la información es la intimidad con las tecnologías y su proceso creativo. Y esto tiene un impacto directo en la formación docente porque forma parte de su misión profesional y porque la tecnología aún no es uno de los ejes centrales de su formación. Preocupado por las implicaciones de esta realidad, EDUCITEC propuso a la comunidad científica el "Dossier de Docencia e Innovación Tecnológica: Perspectivas para el Futuro Próximo". En este sentido, esta breve comunicación tiene como objetivo presentar de manera sucinta la temática y los hallazgos de los estudios seleccionados.

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Introduction

The information age generates a series of demands on organizations and institutions that differ from those based on different foundations. Information is the direct result of handling data, which constitutes its primary raw material (Mosbah; Ali; Tahir, 2023; Mingers; Willcocks, 2023; Pedraza; Vollbracht, 2023). Data collected and handled appropriately generates valid information (Nascimento-e-Silva, 2023; 2021), increasing the probability that derived information will be created. A collection of information develops knowledge (Mingers; Willcocks, 2023; Ane; Nepa; Khan, 2023; Wang *et al.*, 2023; Tan; Pei, 2023) which, in turn, structures, consciously or unconsciously, the actions and human productions. Technological teaching can be framed as a set of actions and human productions, which has characterized the demand for new modalities of knowledge transmission in information societies.

Technological teaching still challenges scientific communities of various specialties, not just educational ones. In 2023, 320 studies on this phenomenon were made available on Google Scholar in English and 743 in Portuguese. These data show a more significant concern for Brazilian science about international science

with the understanding of technological teaching and, consequently, with the deployment of this knowledge into educational practices and the generation of educational technologies for this purpose. In this effort, the Journal of Studies and Research on Technological Teaching (Educitec) has played a fundamental role by evaluating and disseminating knowledge capable of being used as a basis for producing new knowledge and generating technological resources and innovative procedures for this education modality.

The Dossier, now delivered to the scientific community, fulfills the magazine's institutional mission in a particular way, targeting technological teaching and innovation and outlining future perspectives and their implications for teacher training. In this sense, this brief communication aims to briefly present the theme of the Dossier and the studies it comprises. To this end, first, the expectations of the central phenomena (technological teaching and innovation) will be presented. Then, the findings of the studies that make up this edition and their final considerations will be summarized.

Technological teaching and innovation

Technological teaching does not yet have a conceptual definition widely accepted by the scientific community, as it is a field under construction. However, the available studies indicate the different focuses and ways it has been empirically operationalized. Thus, at least two large groupings can be identified: technological teaching mediated by technologies and technological teaching as a process. Examples of the first grouping are the studies by Minamatov *et al.* (2021), Mutiani *et al.* (2021), Clark-Wilson, Robutti, and Thomas (2020), and Khatoony and Nezhadmehr (2020), among several others, while studies such as those by Muñoz *et al.* (2022), Tanak (2020) and Tondeur *et al.* (2020). In short, technological teaching studies seem to focus on the use of technology and teaching procedures as the technology itself.

Innovation, specifically technological innovation, seems to give meaning to technological teaching. The reason is simple. Teaching only mediated by technologies would be teaching done with technologies, naturally, while innovation in the teaching process could be taken as just something that is done differently from others. What the scientific literature seems to signal is that to be technological, teaching would have to have a technological purpose. We are suspicious that the teleological character of technological teaching is the generation of technologies. This means that when teachers and students (now called instructors, tutors, apprentices, or partners) use technological resources or invent new teaching procedures, they have the production of technologies in mind. It seems to be for this reason, for example, that the most sophisticated spaces for technological teaching are called maker spaces, as can be seen from studies by Freiman and Lingley (2024), Ahmadpour *et al.* (2024), and Ferguson, Van Velzen and Olechowski (2024), among others. Of course, this is all just hypothesis and presupposition.

Hence, the more extraordinary assumption is that technological teaching would provide greater chances of teaching, leading to technological innovation, which, in turn, would allow an adequate understanding of different societies and their cultures and subcultures. We imagine that when apprentices and instructors handle technologies to produce technologies, they gain technological skills and understand more adequately the different and diverse roles and the importance of technologies and technological innovations for improving the quality of life and their associated human life. As life is much broader than technologies and innovations, traditional knowledge is more likely to be understood and preserved.

Perspectives for the near future

The prospects for the near future were concerns arising from assumptions about the countless possible relationships between technological teaching and innovation. Numerous questions arose, and all of them focused on teacher training because it is these professionals who, even now, have the mission and challenge of

helping build the knowledge that will continue the evolution and development of the information society. Will makerspaces make traditional classrooms obsolete? Can all content be processed using technology? Will it be possible to equip all learning spaces with all types of technologies that the numerous contents require? If a positive answer exists to one of these questions, the teaching profession must be reviewed and modified.

The study by Dalmau, Tosta, Mendes, and Peralta focuses on the online international collaborative learning experience between students and teachers from Brazilian and foreign universities. Interestingly, it shows technological teaching as a process mediated by technology. The findings point to important implications for teacher training from the perspective of technological processes and resources and fundamentally from the human dimension. The study seems to suggest that human nature makes or hinders the effectiveness of technological teaching.

Silva Júnior and Ferrete's study shows that music is an essential learning tool for teaching Sociology content. Melody, harmony, and rhythm provide the appropriate mental environment for reflection, while the lyrics and melody can transmit and provoke fascinating understandings of curricular content. Furthermore, music motivates and opens up countless possibilities for pedagogical interconnections.

Afonso, Silva, and Bedin studied the significance of integrating digital information and communication technologies with the study of Chemistry, assuming that these resources would provide more dynamism and attractiveness to teaching activities. The results showed that the majority still prefer traditional classes, such as explanations on the board and exercises, but without neglecting technological resources because they are tools that make classes more interesting. Here, technologies and traditions must be integrated for more effective learning gains.

The study by Samussone, Lauriano, and Silveira focused on implementing a higher education evaluation system. The objective was to determine whether the implemented system contributed to developing technological and innovative education in Mozambique. The findings showed improved teaching infrastructure, course curricula, and teacher training. However, the challenges of scarcity of financial resources and difficulty accessing doctoral courses for teachers persist. Innovation as a resource and as a procedure has led to improvements in teacher training, but prospects still need to overcome other challenges.

Itokazu and Medeiros present the findings of a study aimed at categorizing the productions of Brazilian professional master's degrees. The focus was on dissertations that adopted a mixed methodological approach, which has been the most frequent in different fields of knowledge. The results showed that only 16.2% of the dissertations analyzed used all components of the mixed design, while the remaining 83.8% failed to meet the criteria for this type of design. Here emerges the extreme precariousness of understanding quantitative techniques and procedures, with the mistaken mentality that numbers do not provide the same depth as explanations generated with words.

Design thinking and creative learning were the phenomena studied by Costa and Barreto to establish possible convergences from the perspective of innovative technological teaching (ETI, from acronym in Portuguese). The findings showed possibilities for convergence between the five components of the creative learning spiral and the design thinking stages. This study concludes that the convergence of these two phenomena can develop people's innovative capacity, which is the ETI perspective, which causes transformations in agents (learners and instructors), knowledge, and the various instances of life (social, psychic, interpersonal, etc.).

Menta and Brito studied artificial intelligence (AI) and technological teaching to identify their trends. The first discovery was the realization that the tool was applicable in education as long as teacher training was modified, which was the second discovery. The necessary modification involves mastery over AI, especially in programming, use, data privacy and security, personalization of teaching, and total accessibility.

These studies seem to confirm the two large groups of studies on technological teaching (on resources and procedures) and the need to expand knowledge on new tools, materials, and devices; in short, technological artifacts and new processes lead to significant learning in compliance with the information age. Future

perspectives on teacher training are relatively straightforward only in the sense that they cannot continue as they are. The teacher in demand today is the one who knows technologies, knows how to use them, has mastery over technological creation, and is capable of monitoring people's group learning. For this to be possible, the necessary training needs to encompass knowledge and skills from other areas, mainly those in the engineering field, such as production engineering, product engineering, design, computer engineering, software engineering, etc.

FINAL CONSIDERATIONS

This dossier presented seven studies on the future perspectives of technological teaching and innovation and their implications for teacher training. These studies generally focused on technological teaching through technological resources and teaching procedures. Everyone also pointed out, in different ways, the necessary development of this teaching modality so that the learning achieved can be in tune with the demands of information societies, which shape current times. Students and teachers must be familiar with technologies to understand their importance and different roles in improving the quality of life and the associated human life.

The innovations described in the studies involve materials, tools, instruments, devices, and artifacts that can be used in teaching procedures in different environments, especially maker spaces. However, many of these devices require adjustments to the environments where they will be used or created and changes to traditional teaching procedures. Both the use and creation of technologies and the invention of teaching procedures are specific missions of teachers for these new times. And this all needs to be part of the curricular components of their training.

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