International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2024, Vol. 20, Issue 3, pp. 115-132

Teaching Practices and Skills Towards Integrating Digital Information and Communication Technologies in Face-to-face Higher Education

Victor Canella, Maria Batista, Áurea Sousa & Maria Rocha
University of the Azores, Portugal

Luisa Canella
Bahia State University, Brazil

ABSTRACT

This study addresses the integration of Digital Information and Communication Technologies (DICT) in higher education in Brazil. The objective was to present teaching practices and skills necessary to effectively use DICT. Eight interviews were carried out with teachers experienced in integrating DICT in both face-to-face teaching and e-learning. Data analysis was carried out using the IRAMUTEQ software supported by the literature related to the topic. The results highlighted practices that include the use of tools such as Microsoft Teams, Google Classroom, Kahoot! and Padlet. In a broader analysis of practices, it was found that teachers must understand students' needs, plan activities aligned with the pedagogical objectives, and stay up to date with technologies and active teaching methodologies. Essential skills for integrating DICT include deeper knowledge of the functioning and operation of various technologies, a theoretical understanding of the role of these technologies in the educational process, and a solid knowledge of the content to be taught to effectively integrate technology and achieve pedagogical objectives. Skills to teach effectively using digital technologies, promote their ethical and safe use, and a commitment to ongoing professional learning and engagement in professional networks are also essential.

Keywords: *Higher Education; Digital Information and Communication Technologies; Teaching Practices; Pedagogical Objectives; Active Teaching Methodologies*

INTRODUCTION

Earlier studies have noted that digital Information and Communication Technologies (DICT) have become driving forces that shape the dynamics of society and organisations (Rosso, 2015). Interactions, forms of negotiation, and access to information were revolutionized, presenting unprecedented alternatives for building knowledge, entertainment, and relationships (Punie & Redecker, 2017).

The labour market has not remained immune to this technological revolution. The relationships between employers and employees, as well as work dynamics, were profoundly influenced by these new tools (Veloso & Dutra, 2010; Rosso, 2015; Dias & Meirinhos, 2020). The nature of some occupations has changed; for example, traditional agricultural activities are merging with technology, thriving e-agriculture, which has required farmers to adapt to these new realities (Valente, 2018). However, the interaction and acceptance of these technologies have varied significantly among generations with older generations facing greater challenges (Mariano *et al*., 2019). Other studies, for example, show that baby boomers were often seen as resistant to change and reluctant to incorporate new tools into their daily routines (Rosso, 2015). On the other hand, it is crucial to recognize that DICT affects all age groups, from generations Y and Z to baby boomers and generation X. Each generation faces its challenges and opportunities in the digital age.

The incorporation of DICT in the educational sector has profoundly transformed the teaching and learning landscape. Experiences such as the one in the district of Huntsville, Alabama, where

textbooks and notebooks were replaced by laptops, illustrate a global trend towards digitalisation of education (Moreno, 2013). Even though the literature indicates, to a certain extent, that there is inequality concerning access to DICT between individuals from developed and undeveloped nations (Moura & Borges, 2022; Nishio *et al*., 2022; Geremias, 2023; UNESCO, 2023), education in knowledge-emerging economies can become pedagogically effective by adopting a blended learning approach (Sinha & Bagarukayo, 2019). According to Fuentes *et al*. (2019), DICT has the potential to catalyze significant changes in educational methodologies, as long as they are used effectively.

Given the significant impacts of DICT on professional relationships, including in the educational area (Valente, 2018) and the ubiquity of digital devices and the duty to help students become digitally competent, requires teachers to develop a wide range of skills, as well as their digital competence (Punie & Redecker, 2017). In this sense, it is necessary to be flexible and technologically competent to adapt to this constantly changing world (Kirmizi *et al*., 2021). Being technologically competent goes beyond the ability to use digital tools; it is about the teacher's ability to understand how to effectively integrate them into the pedagogical process. Mariano *et al*. (2019) emphasized that, despite daily coexistence with DICT, individuals, teachers included, have different levels of interaction and acceptance of technology. Therefore, continuous and adapted training is essential to ensure that educators are not only comfortable but also effective in the implementation of technology-assisted pedagogical strategies.

Livingstone (2004), highlighted society's growing need to facilitate the acquisition of skills and abilities to use DICT effectively and safely. In the educational context, this translates into preparing teachers to create learning environments that are, at the same time, technologically advanced and pedagogically sound.

The need to map and understand both teaching practices concerning DICT and teaching skills to implement these practices has become vital. Therefore, this study is aimed at presenting teaching practices using DICT in the context of teaching face-to-face in higher education in Brazil and proposes, based on literature, the skills necessary to implement these practices

THE IMPACTS OF DICT IN EDUCATION

When talking about technology, individuals tend to associate it with the digital world. However, as noted earlier by (Lima *et al*., 2013) technology is not restricted only to that). This vision that relates technologies to the digital world was mainly due to the popularization of the Internet, which enhanced the use of DICT in various fields.

The transformations brought by the Internet and the new DICT affect different sectors of society, including education. This results in new challenges for educational institutions and teachers related to the way they teach and mediate knowledge through the use of these technologies (Santos & Teixeira, 2020). For Bártek & Nocar (2016), education can be carried out at any time and any place in which technology is available.

Education found in technological resources a way to reinvent itself and eliminate barriers imposed by traditional means to deliver education. Among twists and hybridism of models aimed at transmitting information, online education (Tavares-Silva *et al*., 2014), as well as face-to-face teaching using DICT, was established to make teaching more attractive and dynamic for students (Smith, 2004; Becker, 2010; Valente, 2018).

Despite the evident positive impacts of DICT in the classroom, the use of technological resources can face some resistance from teachers. For example, the use of smartphones by students in the classroom (Valente, 2018). In this sense, the actors responsible for the teaching-learning process

must be open to the use of DICT; action within the classroom must increasingly be mediated by the use of technological resources (Valente, 2018; Santos & Teixeira, 2020).

In the interaction between machines and students, the presence of a mediator who can help students in their journey of acquiring knowledge is crucial. As the earlier studies have shown, building knowledge involves attentive monitoring of the learner, seeking to understand their real activities and progress (Tavares-Silva *et al*., 2014). In other words, building knowledge is the ability of the interventionist to propose challenges to the students and help them attribute meaning to what is being accomplished (Valente, 1999).

It is important to highlight that globalization, as Santos (2008) pointed out, has brought several problems to society, such as unemployment, poverty, average wage reduction, and, notwithstanding, higher costs in high-quality education. It is worth mentioning that several studies have indicated that teachers' practices are not purposefully oriented towards the dissemination of an education focused on Science and Technology Studies (STS) and Critical and Creative Thinking (CCT) among students (Magalhães & Tenreiro-Vieira, 2006; Szabo & Schwartz, 2011). In this sense, it is even more necessary for teachers to develop conscious didactic-pedagogical practices aimed at CCT, as only in this way will it be possible to make students critical and creative citizens (Tenreiro-Vieira & Vieira, 2022).

Using DICT or integrating them into educational practices was defined by Hew & Brush (2007) as the use of computing devices, such as desktop computers, laptops, handheld computers, software, or the Internet in the classroom. In a broader view, the Learning Technology Standards Committee - LTSC (2007) stated that technology-supported learning can be based on: computer-based training systems; interactive learning environments; intelligent computer-aided instruction systems; distance learning systems; and, collaborative learning environments.

It is important to understand that the main customers of educational institutions, both primary and secondary, are students. According to Valente (2018), the vast majority of students were born in the technological era and will certainly have difficulties attending expository classes (lectures). For the author, these students prefer to read content through digital resources rather than printed material.

At the beginning of this millennium, faced with technological innovations, Perrenoud (2000) stated that it was necessary to consider that educational policies had changed and that teachers and schools had a new role, among which the following stood out: the individualization and diversification of training paths; introduction of learning cycles for students; emphasis on formative rather than normative assessment; development of teaching teamwork; placing the student at the centre of the pedagogical action; use of active methodologies; and, working with problem situations.

Given this, educational institutions must be aware of the evolution of digital technologies and how they are changing and can change teaching and learning processes (Santos & Teixeira, 2020). We are talking about the need to adapt the traditional teaching model – in which the teacher's objective is only to transmit information and does little to help build knowledge, that is, they have been teaching their classes without using technological resources and the students are left behind their desks writing down all the content on a sheet of paper (Valente, 2018) – bringing innovations into the classroom, using digital technologies aimed at improving learning results.

For Fuentes *et al*. (2019), although it was clear that educators have started to integrate DICT into the productive teaching and learning process – used to replace traditional teaching models –, fundamental changes have not yet been seen, given that technological resources are used only as accessories. Furthermore, the authors highlighted the lack of innovative methodologies aimed at integrating technologies.

Therefore, for DICT to be correctly integrated into the teaching and learning process, the teacher must have certain knowledge, skills, and attitudes to achieve the main purpose in a classroom, which is to build knowledge along with the student.

METHODOLOGY

This research adopted the following structure in terms of its type (i), nature (ii), and approach (iii): utilising field research; exploration, and a qualitative approach.

Field research is aimed at clarifying doubts, validating assumptions, or identifying new interactions through direct observation of events as they occur naturally, collecting and recording relevant data for future analyses (Prodanov & Freitas 2013). Therefore, the question we seek to clarify is: "What are the teaching practices and skills concerning DICT in face-to-face higher education?"

Regarding exploratory research, Prodanov & Freitas (2013) stated that the objective is to gain a deeper understanding of the problem in question, clarifying it or formulating hypotheses related to it. Theodorson & Theodorson (1970), who also had the same understanding as Prodanov & Freitas (2013), defined exploratory research in more detail and stated that such research can use any variety of techniques – usually with a small sample, allowing the researcher to define their research problem and formulate their hypothesis more precisely.

Within this perspective, interviews were carried out with a sample of eight professors from Brazilian public universities. The focus was to elucidate and deepen knowledge regarding pedagogical practices related to the use of DICT. This initiative sought to achieve a more in-depth understanding of the issue presented. The questions were asked to the participants of this research to answer the research question: *What are the ways that you, as a teacher, use DICT in your classes?*

In addition to the above, other questions were asked of the interviewees to further deepen the understanding of teaching practices concerning DICT. The interviews took place virtually, using the Microsoft Teams video calling platform, and all interviewed teachers who agreed to participate in the research indicated acquiescence to a virtual informed consent form. This research respected all ethical procedures for data collection and was approved by the Ethics Committee for Research of the University of the Azores under number 14/2023 and distribution UAC/2022/26660.

From this, a content analysis was carried out from the perspective of Bardin (1977), which followed the three proposed chronological poles: i) pre-analysis: ii) exploration of the material; iii) treatment of results, inference, and interpretation.

The interviews were recorded with consent and transcribed in full. A synthesis of each of the responses relating to each of the questions was prepared for pre-analysis. Then, a textual corpus was created covering all interviews. In the second phase, the exploration of the material involved coding the textual corpus. This phase requires the researcher to segment the material according to defined categories, grouping the responses of all interviewees, according to the sequence of questions and interviews.

After coding the textual corpus, the R Interface for Multidimensional Analysis of Texts and Questionnaires (IRAMUTEQ) software was used. Camargo & Justo (2013) earlier explained that IRAMUTEQ offers a range of text analyses from basic word frequency counting to more advanced methods, such as Descending Hierarchical Classification (DHC) and Similarity Analysis.

We chose to use DHC which, for Reinert (1990), referred to the combination of segmentation techniques, hierarchical classification, dichotomy based on factor analysis and dynamic clusters. Camargo & Justo (2013) argued that IRAMUTEQ facilitates the analysis of qualitative data through

DHC, employing a post-factor analysis that maps words and variables in a two-dimensional graph. The software interface allows access to the text segments linked to each class, providing context to statistically relevant words and enabling a more in-depth qualitative analysis.

In summary, the analysis method was as follows: i) initially, data were organized and prepared for analysis, that is, textual corpora were created for each of the interviews; ii) then, all data were read in detail, with repeated re-readings to evaluate the transcribed content and generate a summary of the data collected; iii) it involved detailed data coding using the IRAMUTEQ software, which generated DHC dendrograms for each of the questions asked to participants; iv) all classes presented in the dendrograms were evaluated and new analyses of the interviews were conducted; v) the results were presented based on the interpretation of dendrogram data and on the literature consulted.

RESULTS AND DISCUSSION

Initially, information was collected from the interviewees about their relationships with DICT, such as training, professional experience, research areas, and teaching modalities.

The interviewees are significantly experienced as teachers at different levels of education. Their research areas are varied, covering topics such as intelligence technologies, digital design, pedagogical models for distance learning, educational recommendation systems, educational technologies, competency-based curriculum in professional education, teacher training, digital competencies in education and digital technology applied to education. One professor does not have a doctorate (only a master's degree) and only two interviewees work in the face-to-face modality exclusively, while the others work both in distance learning and in-person teaching.

Based on the interview data, IRAMUTEQ, after carrying out the DHC, generated a dendrogram with seven classes of words. The word classes for the question related to the ways of using DICT in the teaching-learning process which suggested different ways of use, are shown in Table 1.

Table 1: *The use of DICT based on the dendrogram generated by IRAMUTEQ*

<table>
<tr><td>Technological tools used</td><td colspan="2">Microsoft Teams, Google Classroom, Padlet, Kahoot!, Moodle, StreamYard, Polling and Gamification tools.</td></tr>
<tr><td rowspan="2">Provision of material via Virtual Learning Environment</td><td colspan="2">Moodle and Microsoft Teams</td></tr>
<tr><td>Activities Elaboration</td><td>Infographics, polls, quizzes, games.</td></tr>
<tr><td>Use of social networks and online communities</td><td colspan="2">Blog creation activities and development of written communication skills.</td></tr>
<tr><td colspan="3">Assessment and feedback via Virtual Learning Environment and social networks</td></tr>
<tr><td>Diagnostic tools to assess previous knowledge</td><td colspan="2">Microsoft Teams, Moodle, Kahoot!, Games.</td></tr>
<tr><td>Integrating DICT to active learning methodologies</td><td colspan="2">Flipped classroom, rotation by station and gamification</td></tr>
<tr><td colspan="3">Promoting student autonomy for research, creation, and development of skills in the digital environment</td></tr>
</table>

Source: Research Data (2023).

The use of various technological tools while teaching in the face-to-face modality, such as Microsoft Teams, Google Classroom, Padlet, Kahoot!, Moodle, StreamYard, and other polling and

gamification tools, is a practice that, according to the data collected, can provide more quality to face-to-face teaching.

Some tools, such as Moodle and Microsoft Teams, despite being solutions for e-leaming (Machado, 2008; Abar & Dias, 2021) are, according to those interviewed, useful tools when it comes to face-to-face teaching. The research carried out by Santana & Cruz (2014), which was based on the construction of an online room for the interaction of students in a face-to-face discipline, demonstrated that the use of Moodle is an effective strategy that can increase the engagement of both students and the teacher regarding interactions.

The interviews corroborate the importance of DICT for the inclusion of students with disabilities, such as hearing and visual. Moodle is mentioned as a platform that can be adapted to meet these needs, increasing the font size for students with low vision capability or using descriptive audio for blind students, for instance. The focus is on making education more accessible through technological adaptations.

Moodle is also highlighted as a useful electronic system for creating and administering online assessments. This use of the tool allows the teacher to monitor student behaviour in a virtual learning environment, such as who is accessing it, time spent in it, completion of activities and the level of student engagement.

Kahoot! is cited as a tool for student assessment that encourages engagement and competition among students. This tool was mentioned as enhancing the student's protagonism in learning. In one of the interviews, it was reported that Kahoot! after several learning experiences using DICT, was the tool chosen by students for developing virtual competitions in their seminars.

Although there are challenges and room for improvement, Wang & Tahir (2020) carried out an analysis of 93 studies on Kahoot!, showing that the tool tends to improve learning and classroom dynamics, reduce student anxiety, and be positively received by students and teachers.

Tools such as Moodle and Microsoft Teams were also cited as important means of making materials (such as articles, handouts, books, and power point presentations.) available to students. Padlet, for example, was mentioned in the interviews as being an important ally in promoting greater engagement on the part of students.

Beltrán-Martin (2019) used Padlet as an online collaborative learning tool to create a collection of teaching materials. This approach resulted in high student satisfaction and good academic performance. Advantages included its ease of use and flexibility, which encouraged students' reflection on their learning and improved their interpersonal and management skills.

For successful integration of DICT, it is crucial to consider existing barriers, such as limited Internet access, insufficient managerial and technical support, negative attitudes, and lack of skills with DICT (Hew, & Brush, 2007). The research by Rossi *et al*. (2021), carried out during the COVID-19 pandemic, showed that elementary school teachers faced challenges in using Microsoft Teams for remote classes, such as lack of platform know-how, Internet difficulties, low student engagement, and technological issues, highlighting inequalities in access to education. One of the main findings of the research carried out by Sinha & Bagarukayo (2019) revealed that in emerging economies, such as Uganda and India, the effective use of technologies, mainly in the e-learning model, requires improvement of basic teaching infrastructure.

The existence of inequality in access to DICT is a fact, especially in undeveloped and underdeveloped countries. Therefore, for the use of open access resources – such as Microsoft Teams, Google Classroom, Padlet, Kahoot!, Moodle, StreamYard, and other polling and

gamification tools – to be integrated into the teaching-learning process, existing barriers need to be overcome, starting with those that require the action of educational institutions.

Social networks, which were practices cited by interviewees in the teaching and learning process, are tools or online environments that support people's interactions, such as Podcasts, Blogs, Microblogs and Visual Social Networks (Goulart, 2014). Juliani *et al*. (2012) proposed a guide for the use of Facebook in higher education, highlighting institutional and teaching responsibilities. Teachers' responsibilities included: i) promoting interactivity and support through chats; ii) publishing educational content, such as class materials and schedules; iii) evaluating students' work on the network; iv) encouraging debates to reinforce learning; v) managing online content and events, keeping pages updated; and vi) teaching ethics and digital responsibility, balancing personal and professional aspects.

Virtual Learning Environments (VLE) such as Microsoft Teams, Google Classroom and Moodle may not be as well known to some students and teachers, as seen in the research by Rossi *et al*. (2021). However, social networks such as Facebook and Instagram are used by the majority of the world's population (Statista, 2023), and have similar functionalities to the aforementioned VLEs, and can become more attractive in the educational environment.

The use of Instagram for educational purposes has generated several contributions to teaching-learning, such as collaborative work, student autonomy, creativity, curiosity, and fun in the knowledge construction process (Pereira *et al*., 2019; Pereira *et al*., 2023; Ibiapina & Gonçalvez, 2023; Rodrigues *et al*., 2023). Therefore, the use of these social networks along with traditional VLEs can become a successful strategy, since they are digital environments that students are more familiar with.

In the assessment process using DICT, the teachers interviewed reported using VLE and social networks. They incorporate tasks such as creating blogs and writing texts, exercising creativity by integrating other tools, such as Kahoot!, Padlet and Wordwall, to make assessments more engaging.

To effectively incorporate DICT into teaching-learning, it is crucial to choose appropriate technologies. Santos & Vilarinho (2020) highlighted essential categories for the successful use of media and technologies in distance learning: understanding the target audience (age, interests, autonomy); pedagogical integration (respecting the peculiarities of teaching and technology); necessary human resources (teamwork); technological resources (compatibility with the chosen media/technology); and infrastructure (considering organizational economic factors).

Although the categories cited by Santos & Vilarinho (2020) were focused on integrating DICT into distance learning, in face-to-face classes, the categories align with the proposals of several authors: Perrenoud (2000) emphasized the importance of teamwork in technology integration; Hew & Brush (2007) pointed out barriers related to infrastructure and economic and organizational issues; Smith (2004), Becker (2010), and Aguiar & Flores (2014) discussed the need to align Digital Learning Objects with the pedagogical objectives.

Participants in this research also highlighted the use of tools such as Kahoot! and Wordwall for diagnostic assessments of students' prior knowledge, aiming to make the assessment more engaging. This practice helps educators personalize teaching, adapting to students' different needs for effective lesson planning and achieving pedagogical objectives.

The data in Table 1 highlights the integration of DICT with active learning methodologies and students' autonomy in this integration. Bulegon & Mussoi (2014) observed that many educators resist innovative methods that combine DICT and pedagogical practices. Such resistance is evident

in teachers' justifications, which are based both on educational theories such as behaviourism, cognitivism, and constructivism and on their experiences in the classroom.

Fuentes *et al*. (2019) noted that although it is evident that educators have started to integrate DICT into the teaching-learning process – in which DICT is used to replace traditional teaching models – fundamental changes have not yet been seen, given that technological resources are used only as accessories. The authors highlighted the lack of innovative methodologies aimed at integrating technologies.

According to Valente (2018), the use of digital technologies in the classroom is still far from ideal. However, educational institutions have been making efforts to ensure that technological innovations are used by teachers as a way to improve teaching. Highly regarded universities such as Michigan State and Case Western Reserve already use technologies to improve active learning methodologies experience.

If used as teaching tools in everyday teaching, active learning methodologies present an option to the traditional model. According to Freire (1996) knowledge is transmitted uniformly by the teacher without considering the different ways that students learn. Therefore, active learning methodologies are related to pedagogical practices to reach students and engage them in activities in which they are protagonists of their learning (Valente, 2018; Canella, 2023).

Making students protagonists through the use of active methodologies means making them autonomous. As the interviews highlighted and literature indicates, active learning methodologies such as, for example, problem-based learning (Bouth *et al*., 2023: Caporal & Semeniuk, 2020, Junqueira & Wildner, 2017, Martinez Casanovas *et al*., 2022; Oliveira, 2019), project-based learning (Costa *et al*., 2022; Lopez & Palácios, 2023), flipped classroom (Pereira & Silva, 2018, Sandhu *et al*., 2019; Valente, 2018), and the use of games (Canella, 2023; Jääskä & Aaltonen, 2022; Zaluski & Oliveira, 2019), are inseparable elements when wanting to integrate DICT into the learning process.

However, it is essential to maintain a balance when using DICT in the classroom. An educator who relies excessively on technology can make the teaching-learning process tedious, negating the benefits that these tools offer to education. Technologies, in the view of those interviewed, should not be seen as an end in themselves, but rather as a means to achieve certain educational objectives.

A more global analysis of the results that took into account both the practices presented here and the other information provided by the participants through other questions asked during the interview enabled the construction of the mind map represented in Figure 1.

Each group on the mind map represents behaviours to be followed by teachers to integrate DICT into education. Figure 1 can be read by orienting clockwise, starting from the yellow quadrant. In this way, the yellow quadrant demonstrates the need for teachers' understanding concerning students' needs. This compression serves as a basis for personalizing teaching, as it involves the socioeconomic context, the level of digital literacy (media and information), deficiencies, and/or students' learning difficulties, among other factors.

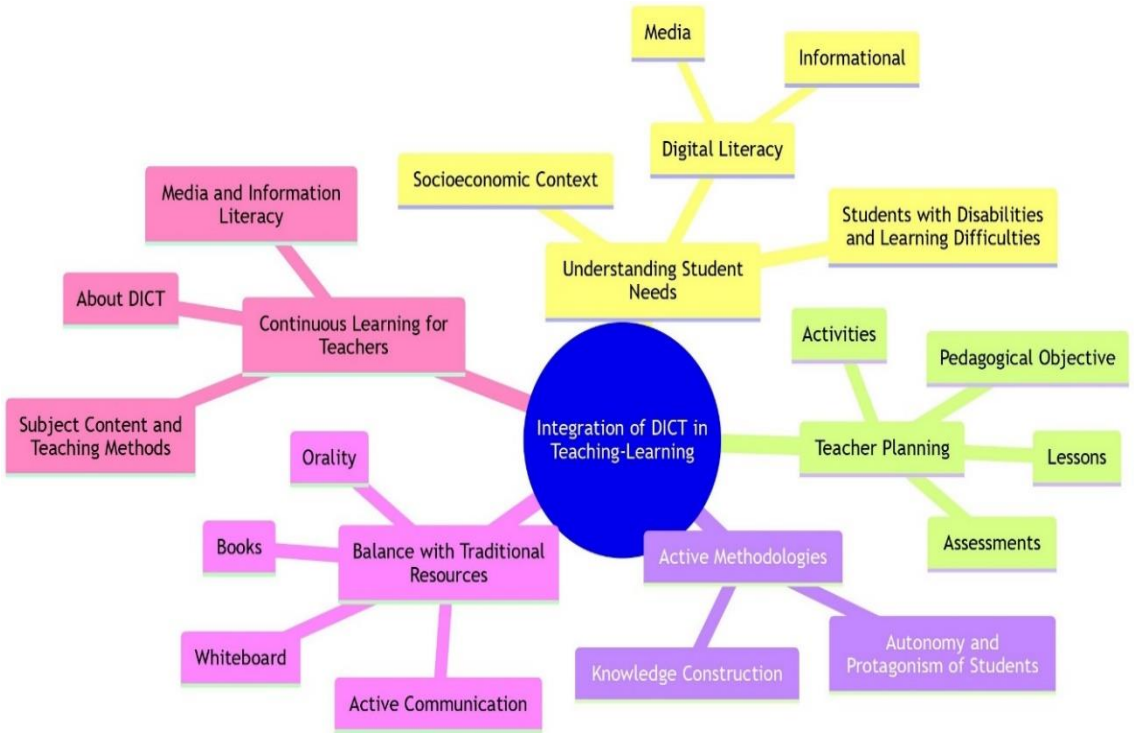

Figure 1: Conduct mind map for the integration of DICT

After this understanding, the green quadrant demonstrates the need to carefully plan classes, assessments, and other activities carried out in person so that the integration of DICT is aligned with the pedagogical objectives. In this sense, planning must include the use of active learning methodologies that can be visualized through the lilac quadrant aiming at giving the student more autonomy in knowledge construction.

However, DICT does not replace traditional teaching resources. Therefore, the pink quadrant highlights the importance of there being a balance in the use of DICT, in which the teacher begins combining traditional tools, such as whiteboards, books, orality, and active communication to keep the student engaged and autonomous.

Finally, for effective continuity of technological integration, it is necessary for teachers to continually seek to learn about DICT, subject content, innovative teaching methods, as well as media and information literacy, as presented in the last quadrant.

Teaching skills regarding DICT

Being digitally competent, according to Janssen *et al*. (2013), refers to a set of knowledge, skills, and attitudes associated with different purposes (such as communication, creative expression, information management, and personal development), domains (daily life, work, privacy and security, legal aspects), and levels. In a simplified view, Silva & Behar (2019) stated that being digitally competent is linked to the technological domain, in which the individual will mobilise a set of knowledge, skills, and attitudes, aimed at solving problems in digital media.

Competency frameworks, such as Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006) and Substitution, Argumentation, Modification, and Redefinition (SAMR) (Puentedura, 2006), are widely recognized for focusing on technological, pedagogical, and content

knowledge. However, Falloon (2020) argued that these models are insufficient for current and future educational environments, as they do not cover essential areas other than those mentioned.

Proposed by Falloon (2020), the Teacher Digital Competence (TDC) presents itself as an alternative competency structure for teachers that combines elements of TPACK and areas such as ethics, behavioural, personal, social, and environmental aspects concerning the use of technology, as seen in Figure 2.

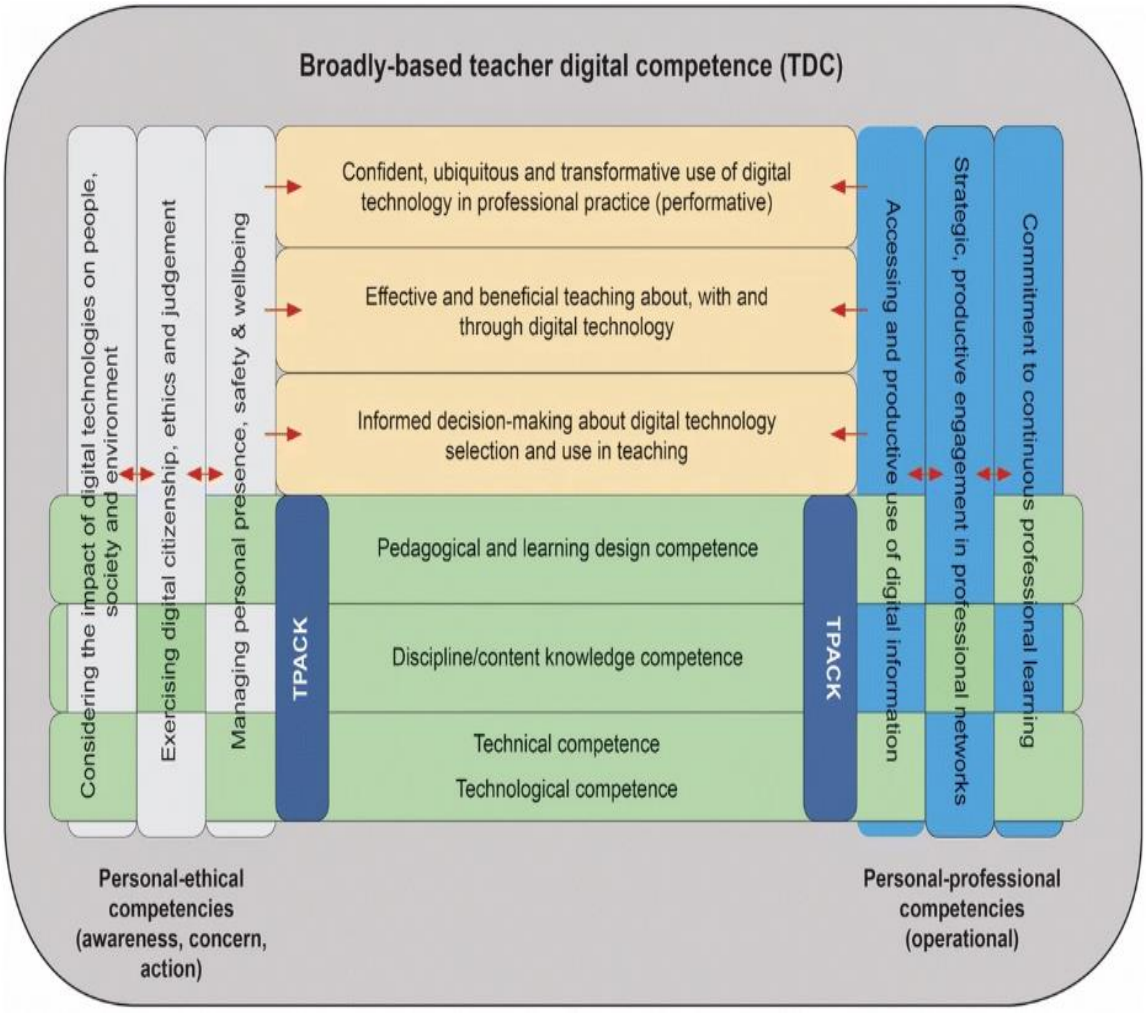

Figure 2: Teacher Digital Competence

Digital competency frameworks are useful for teachers, providing guidance on the knowledge needed to teach with DICT and helping to build the capacity to overcome gaps in technological skills (Ogegbo, 2023).

Based on TDC and the interviews, Table 2 below presents the essential skills for teaching practices with DICT agreed by the interviewees.

Table 2: *Teacher digital skills*

TDC competence	Description	Relationship with interviewees' practices
Technical Competence	Robust knowledge of the functioning and operation of various digital technologies such as mobile devices, applications, network services, etc.	Use of tools such as Microsoft Teams, Google Classroom, Moodle, Social Networks, etc.
Technological Competence	Theoretical understanding of the role and potential of digital technologies in teaching and learning.	Effective integration of tools such as Padlet, Kahoot!, StreamYard and gamification using DICT.
Competency in Subject/Content Knowledge	Solid knowledge of the content to be taught for effective technological integration and alignment with proposed pedagogical objectives.	Preparation of materials and teaching activities such as infographics, surveys, and games.
Competency in Pedagogical and Learning Design	Ability to teach effectively with, about and through digital technologies, including selection and use of digital resources.	Creating engaging learning environments and class management.
Ethical-Personal Competence	Understanding and modelling teaching content that promotes ethical use and secure digital resources.	Students' online presence management, well-being, and engagement.
Personal-Professional Competency	Includes commitment to continuous professional learning and strategic engagement in professional networks.	Constant updates on emerging technologies and promotion of student autonomy for research.
Skills Integration	Combination of ethical-personal and personal-professional skills with the essential skills aligned with TPACK.	DICT integration with active learning methodologies and promotion of student autonomy.

The comparison of the competencies in Table 2, based on TDC (Fallon, 2020), with those related to DICT by Borges Canella *et al*. (2024) was carried out to meet the need for continuous appropriation of advanced digital skills in an ever-changing world (Punje & Redecker, 2017), generating relevant results and insights as follows:

I. Assessments and use of active learning methodologies with DICT are crucial practices that require skills in Pedagogical and Learning Design and Integration, which highlight the ability to plan, create, or find digital learning objects and implement efficient and engaging teaching strategies with digital technologies.

II. It is essential to use technological resources aligned with pedagogical objectives. To achieve this, the teacher must develop: a) Technological Competence, understanding the role of DICT in teaching; b) Technical Competence, with a practical ability to operate these technologies; c) Competence in Subject/Content Knowledge, having solid knowledge of what will be taught.

III. Teachers must internalize the use of DICT due to its attractiveness and dynamism, continually developing Technological and Pedagogical Design and Learning Skills, to create interactive learning experiences and make teaching even more attractive;

IV. To personalize teaching using DICT, teachers must develop Competencies in Subject/Content Knowledge and Pedagogical and Learning Design. A deep knowledge of the subject enriches teaching-learning, for example, through real examples linked to theory. Also, skills to develop or find attractive digital learning objects adapted to students' individual needs are essential.

V. DICT should be used in education only if it facilitates learning, understood as achieving pedagogical objectives, personalizing teaching and student engagement. Otherwise, traditional tools such as books, whiteboards and active technology-free methodologies are valid alternatives. The use of traditional resources should focus on building knowledge with autonomy for the student, not limited to the banking teaching system (e.g., Freire, 2019). Developing Technological Competence is essential for the strategic use of DICT in the teaching-learning process.

VI. Integrating DICT to make the student the protagonist of their learning is essential, made possible by the development of Competencies in Pedagogical and Learning Design and Personal-Professional, which focus on actively involving students in the educational process.

VII. In a world of rapid changes and new technologies, teamwork, continuous learning, and openness to new things are fundamental. Personal-Professional Competence, which values engagement in professional networks, is key to acquiring new digital skills.

VIII. Access and Productive Use of Digital Information, which is a TDC competency that focuses on effectively obtaining relevant information, is essential for using technologies and developing assessments that stimulate autonomy, critical thinking, and problem-solving.

Through the skills presented, teaching practices can be carried out in more effective ways within the teaching and learning process, serving as a guide in the implementation of conduct in educational institutions, such as teacher training or continuing education programs. Various skills, such as Pedagogical and Learning Design, must be continually developed, given the dynamism of technological tools that emerge day after day.

CONCLUSION

The integration of DICT into teaching-learning emerges as a necessary pedagogical practice, which offers a diverse range of tools that enrich the educational experience. The results of this study suggest that the conscious and strategic use of DICT, such as Moodle, Teams, Padlet, and Kahoot!, in addition to social networks and active learning methodologies, can significantly improve the quality of in-person teaching. These technologies not only facilitate the distribution of teaching materials and student engagement but also enhance students' autonomy and active participation in the knowledge-construction process.

However, for the potential of DICT to be fully accomplished, teachers must be aware of the existing barriers, such as infrastructure limitations and the need for institutional support, which sometimes is non-existent and demotivating. The adoption of a collaborative approach –where teachers with other teachers, teachers with students, and students with other students, create content with the ethical and safe use of digital tools – is at the heart of an effective pedagogy. Furthermore, the ability of educators to quickly adapt to new technologies and the willingness to continue professional learning is crucial for the successful integration of DICT into education.

Educational institutions and educators must seek to overcome inequalities in access to DICT, especially in less developed regions, guaranteeing inclusive and equitable education. Teacher training must emphasize not only the acquisition of technical skills but also the development of active pedagogical methodologies that integrate DICT in a meaningful way. This will imply a continuous movement towards educational practices that value students' creativity, critical thinking, protagonism, and autonomy, preparing them for an increasingly digitalized world.

REFERENCES

Abar, C. A. A. P. & Dias, A. de O. (2021). A Gênese Documental e o Contexto Remoto no Desenvolvimento de uma Formação Continuada de Professores. In *Compreender o Trabalho dos Professores Brasileiros do Ensino Básico: Uma Abordagem pelos Recursos,* pp. 257-276. Blucher. https://doi.org/10.5151/9786555500813-10

Aguiar, E. & Flôres, M. L. (2014). Objetos de Aprendizagem: conceitos básicos. In L. M. R. Tarouco *et al*. (Eds.), *Objetos de aprendizagem: teoria e prática,* pp. 12-28. Evangraf.

Bardin, L. (1977). Análise de conteúdo. *Presses Universitaires de France*, Edições 70.

Bártek, K., and Nocar, D. (2016). Mathematics Education Support by Digital Learning Objects, Conference: 8th International Conference on Education and New Learning Technologies, Barcelona, Volume: EDULEARN16 Proceedings. DOI:10.21125/edulearn.2016.1707

Becker, B. W. (2010). Digital Learning Object Repositories. *Behavioral & Social Sciences Librarian*, vol. 29, no. 1, pp. 86-88.

Beltrán-Martín, I. (2019). Using Padlet for collaborative learning. In Proceedings of the 5th International Conference on Higher Education Advances (HEAd'19). Universitat Politecnica de Valencia, Valencia. https://doi.org/10.4995/HEAd19.2019.9188

Borges Canella, V., Câmara Batista, M.D.G., de Sousa, Á.S.T., Silva Rocha, M.L. & Borges Canella, L. (2024) 'Necessary skills for teachers towards digital information and communication technologies in the current era', *Int. J. Education Economics and Development* (Accepted for publication).

Bouth, R. N., Alves, R. V., Araújo, D. M., Alves, A. D. & Pereira, C. L. (2023). O Arco de Maguerez como Metodologia Ativa da Educação Ambiental: A Problematização da Implantação de Horta Mandala em Ambiente Escolar. *Anais do III Congresso Nacional On-line de Conservação e Educação Ambiental - Revista Multidisciplinar de Educação e Meio Ambiente*, vol. 4, no. 3.

Bulegon, A. M. & Mussoi, E. M. (2014). Pressupostos pedagógicos de objetos de aprendizagem. In L. B. M. R. Tarouco, V. M. Costa, B. G. Ávila, M. R. Bez, & E. F. Santos (Eds.), *Objetos de aprendizagem: teoria e prática*. Evangraf.

Camargo, B. V. & Justo, A. M. (2013). IRAMUTEQ: Um Software Gratuito para Análise de Dados Textuais. Temas em Psicologia, vol. 21, no. 2, pp. 513-518. https://doi.org/10.9788/TP2013.2-16

Canella, L. B. (2023). *Metodologias ativas no ensino de inglês para aviação para sargentos de aviação do exército brasileiro: um estudo de caso*. (Dissertação de mestrado, Universidade de Taubaté).

Caporal, M. R., Vaz, R. S. & Semeniuk, A. P. (2020). Percepção dos Estudantes de Medicina sobre o Uso da Problematização como Metodologia Ativa no Internato em Saúde Pública. Educação: Teorias, Métodos e Perspectivas, 4.

Costa, A. G., Rocha, E. P. & Martins, A. S. (2022). A Aprendizagem Baseada em Projetos – ABP como uma ferramenta de metodologia ativa em tecnologias para a aprendizagem significativa. Revista Amor Mundi.

Dias, B. C., & Meirinhos, V. A. (2020). Carreiras após os 40 anos: a importância das competências digitais. In H. Martins & F. M. S. Silva (Eds.), *Transformação Digital, Dimensões Organizacionais e Societais: Cadernos de Investigação da Escola de Verão do CEOS.PP* pp. 40-45.

Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Educational Technology Research and Development*, vol. 68, no. 5, pp. 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Freire, P. (1996). *Pedagogia da autonomia: saberes necessários à prática educativa*. Paz e Terra.

Freire, P. (2019). *Pedagogia do oprimido* (84ª ed.). Paz & Terra.

Fuentes, J. L., Albertos, J. & Torrano, F. (2019). Hacia el Mobile-Learning en la escuela: análisis de factores críticos en el uso de las tablets en centros educativos españoles. *Education in the Knowledge Society (EKS)*, vol. 20, no. 17. https://doi.org/10.14201/eks2019_20_a3

Geremias, B. M. (2023). Navegar é preciso! Sobreviver é urgente! Metáforas de vida e de educação. Revista Brasileira de Pesquisa (Auto)biográfica, [S. l.], vol. 8, no. 23, p. 1107. 10.31892/rbpab2525-426X.2023.v8.n23.e1107

Goulart, E. E. (2014). O docente nas mídias sociais. In E. E. Goulart (Ed.), Análise de conteúdo em redes sociais virtuais (pp. 11-26). Porto Alegre: EDIPUCRS-Editora Universitária da PUCRS.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Education Tech Research Dev*, vol. 55, pp. 223–252. https://doi.org/10.1007/s11423-006-9022-5

Ibiapina, V. F., & Gonçalves, M. (2023). Instagram: Uma Proposta Digital para o Ensino de Química e Divulgação Científica. *Revista Docência e Cibercultura*, vol. 7, no. 1, pp. 1-25. https://doi.org/10.12957/redoc.2023.66274

Jääskä, E., & Aaltonen, K. (2022). Teachers' experiences of using game-based learning methods in project management higher education. *Project Leadership and Society*, vol. 3. https://doi.org/10.1016/j.plas.2022.100041

Janssen, J., Stoyanov, S., Ferrari, A., Punie, Y., Pannekeet, K. & Sloep, P. (2013). Experts' views on digital competence: Commonalities and differences. *Computers & Education*, vol. 68, pp. 473–481. https://doi.org/10.1016/j.compedu.2013.06.008

Juliani, D. P., Juliani, J. P., Souza, J. A. de. & Bettio, R. W. de. (2012). Utilização das redes sociais na educação: guia para o uso do Facebook em uma instituição de ensino superior. *Revista Novas Tecnologias na Educação*, vol. 10, no. 3. https://doi.org/10.22456/1679-1916.36434

Junqueira, A. M., & Wildner, M. C. S. (2017). Metodologia Ativa Aprendizagem por Meio de Problematização na Educação Profissional. *Revista Destaques Acadêmicos*, vol. 9, no. 4. http://dx.doi.org/10.22410/issn.2176-3070.v9i4a2017.1667

Kirmizi, F. S., Kapikiran, S., & Akkaya, N. (2021). Dijital Ortamda Yazmaya İlişkin Tutum Ölçeği (DOYAT): Ölçek Geliştirme Çalışması. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, vol. 52, pp. 417-444. https://doi.org/10.9779/pauefd.684858

Lima, A. A., Maia, D. V. de. A., Lemos, E., & Queiroz, M. J. de. (2013). *Curso de informática avançada*. IFRN. https://memoria.ifrn.edu.br/handle/1044/872?show=full

Livingstone, S. (2004). What is media literacy? *Intermedia*, vol. 32, no. 3, pp. 18-20.

López, J. A., & Palácios, F. J. P. (2023). Effects of a Project-Based Learning Methodology on Environmental Awareness of Secondary School Students. *International Journal of Instruction*, vol. 17, no. 1.

LTSC. (2007). *The learning object metadata standard*. https://www.ieeeltsc.org/working-groups/wg12LOM/lomDescription/

Machado, A. C. (2008). O desenvolvimento de um curso a distância on-line: relato da experiência utilizando o sistema de gerenciamento de cursos – moodle, como ferramenta de aprendizagem colaborativa. *Revista Paideia*, vol. 1, no. 2.

Magalhães, S. I. R. & Tenreiro-Vieira, C. (2006). Educação em Ciências para uma articulação Ciência, Tecnologia, Sociedade e Pensamento crítico. Um programa de formação de professors. Revista Portuguesa de Educação, vol. 19, no. 2, pp. 85-110.

Mariano, A. M., Ramírez-Correa, P., Alfaro-Pérez, J., Painén-Aravena, G. & Machorro-Ramos, F. (2019). O Papel da Aceitação da Tecnologia nas Cidades Inteligentes: Um estudo das percepções dos usuários do Uber Brasil. *Revista Ibérica de Sistemas e Tecnologias de Informação,* pp. 571-583.

Martínez Casanovas, M., Ruíz-Munzón, N. & Buil-Fabregá, M. (2022). Higher education: the best practices for fostering competences for sustainable development through the use of active learning methodologies. *International Journal of Sustainability in Higher Education*, vol. 23, no. 3, pp. 703-727. https://doi.org/10.1108/IJSHE-03-2021-0082

Mishra, P. & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, vol. 6, pp. 1017-1054).

Moreno, A. C. (2013). *Distrito escolar nos EUA troca livros e cadernos por laptops a 24 mil alunos*. G1. http://g1.globo.com/educacao/noticia/2013/07/distrito-escolar-nos-eua-troca-livros-e-cadernos-por-laptops-24-mil-alunos.html

Moura, M. R. & Borges, M. K. (2022). Práticas docentes nas aulas remotas durante o isolamento da pandemia: reflexões sobre igualdade de acesso às tecnologias digitais. *V Congreso Latinoamericano y Caribeño de Ciencias Sociales. "Democracia, justicia e igualdad" FLACSO URUGUAY*.

Nishio, A. L., Souza, M. P. B., Nascimento, J. C. & Corrêa, C. C. M. (2022). O fazer pedagógico docente com as tecnologias digitais: The teaching process with digital technologies. *Brazilian Journal of Development*, vol. 8, no. 10, pp. 68852–68871. https://doi.org/10.34117/bjdv8n10-255

Ogegbo, A. A. (2023). Assessing the Proficiency Level in Digital Competences of Secondary School Science Teachers. *International Journal of Education and Development using Information and Communication Technology* (IJEDICT), vol. 19, no. 2, pp. 40-57.

Oliveira, S. V. de. (2019). Metodologia ativa de ensino em bioestatística: uma experiência com a abordagem baseada na problematização. *Revista Brasileira De Educação e Saúde*, vol. 9, no. 2, pp. 34-40. https://doi.org/10.18378/rebes.v9i2.6405

Pereira, Z. T. G., & Silva, D. Q da. (2018). Metodologia Ativa: Sala de Aula Invertida e suas Práticas na Educação Básica. *Revista Iberoamericana Sobre Calidad, Eficacia y Cambio en Educación*, vol. 16, no. 4. https://doi.org/10.15366/reice2018.16.4.004

Pereira, A. J., Junior, J. F. da. S. & Silva, E. V. da. (2019). Instagram como Ferramenta de Aprendizagem Colaborativa Aplicada ao Ensino de Química. *Revista Debates em Ensino de Química*, vol. 5, no. 1, pp. 119-131.

Pereira, A. L. da S., Martins, L. L. O., Garcia, T. C. M., Sobrinho, D. M. dos S., & Garcia, T. F. M. (2023). O Instagram como Instrumento Avaliativo na Geografia Escolar. Saberes: *Revista Interdisciplinar de Filosofia e Educação*, vol. 23, no. 2, pp. 281-296. https://doi.org/10.21680/1984-3879.2023v23n2ID33480

Perrenoud, P. (2000). *10 Novas Competências para Ensinar: Convite à viagem*. Porto Alegre: Artmed.

Prodanov, C. C. & Freitas, E. C. de. (2013). *Metodologia do Trabalho Científico: Métodos e Técnicas da Pesquisa e do Trabalho Acadêmico (2ª ed.).* Novo Hamburgo - RS: Associação Pró-Ensino Superior em Novo Hamburgo - ASPEUR Universidade Feevale.

Puentedura, R. (2006). Transformation, technology, and education [Blog post]. http://hippasus.com/resources/tte/

Punie, Y., Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu*, Publications Office of the European Union, Luxembourg. https://dx.doi.org/10.2760/178382

Reinert, M. (1990). Alceste une méthodologie d'analyse des données textuelles et une application: Aurelia De Gerard De Nerval. *Bulletin de Méthodologie Sociologique*, vol. 26, pp. 24-54. https://doi.org/10.1177/075910639002600103

Rodrigues, F. L. A., Oliveira, P. P. M., Brasileiro, B. G. & Ferreira, M. E. R. (2023). Potencialidades Pedagógicas da Rede Social Instagram no Ensino de Espanhol com Alunos Universitários Portugueses. *Revista de Educação a Distância da UFVJM*, vol. 3, no. 1.

Rossi, M., Braun, P. D. L., Carvalho, J. W. P., Miranda, A. F. de. & Mello, G. J. (2021). Desafios enfrentados por pedagogas na utilização de uma nova plataforma: aulas remotas em tempos de pandemia da COVID-19. *Research, Society and Development*, vol. 10, no. 14, e466101421753. https://doi.org/10.33448/rsd-v10i14.21753

Rosso, L. U. (2015). *O impacto das novas tecnologias sobre as competências profissionais da geração Baby Boomer* (Tese de doutorado, Pontifícia Universidade Católica de São Paulo).

Sandhu, S., Sankey, M. & Donald, P. (2019). Developing a flipped classroom framework to improve tertiary education students' learning engagements in India. *International Journal of Education and Development using Information and Communication Technology (IJEDICT),* vol. 15, no. 2, pp. 31-44.

Santana, A. L. & Cruz, D. M. (2014). A utilização da plataforma Moodle para o apoio ao ensino presencial com foco na interação em uma disciplina de pós-graduação. *Simposio Internacional de Educação a Distância (SIED).*

Santos, M. (2008). *Por uma outra globalização* (15ª ed.). Rio de Janeiro: Editora Record.

Santos, A. & Teixeira, A. C. (2020). Por um estado do conhecimento da formação de professores para o uso de tecnologias na educação. *Educação por escrito*, vol. 11, no. 2, pp. 1-10)

Santos, F. G. de A. dos. & Vilarinho, L. R. G. (2020). Instrumento avaliativo para seleção de mídias e tecnologias digitais em cursos a distância. *EmRede - Revista De Educação a Distância*, vol. 7, no. 1, pp. 126–144. https://doi.org/10.53628/emrede.v7i1.544

Silva, K. K. A. da. & Behar, P. A. (2019). Competências digitais na educação: uma discussão acerca do conceito. *Educação em Revista*, vol. 35. http://dx.doi.org/10.1590/0102-4698209940

Sinha, E. & Bagarukayo, K. (2019). Online Education in Emerging Knowledge Economies: Exploring factors of motivation, de-motivation and potential facilitators; and studying the effects of demographic variables. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, vol. 15, no. 2, pp. 5-30.

Smith, R. S. (2004). *Guidelines for authors of learning objects*. http://files.eric.ed.gov/fulltext/ED505110.pdf

Statista (2023). Number of Internet and Social Media Users Worldwide as of January 2023. https://www.statista.com/statistics/617136/digital-population-worldwide/

Szabo, Z. & Schwartz, J. (2011). Learning methods for teacher education: The use of online discussions to improve critical thinking. Technology, *Pedagogy and Education*, vol. 20, no. 1, pp. 79-94.

Tavares-Silva, T., Valente, J. A., Dias, P. (2014). Diferentes abordagens da educação a distância mediada por computador e via internet. *Scitis*, vol. 1, pp.12-21.

Tenreiro-Vieira, C. & Vieira, R. M. (2022). Pensamiento crítico y creativo para una educación ciencia-tecnología-sociedad. *Revista Iberoamericana De Ciencia, Tecnología y Sociedad - CTS*, vol. 17, no. 51, pp. 141–155.

Theodorson, G. A. & Theodorson, A. G. (1970). *A modern dictionary of sociology*. London: Methuen.

UNESCO (2023). *Global education monitoring report, 2023: technology in education: a tool on whose terms?* United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000385723.

Valente, J. A. (1999). Formação de Professores: diferentes abordagens pedagógicas. In: Valente, J. A (Org). *O computador na sociedade do conhecimento*. Unicamp/Nied, Campinas, Brasil.

Valente, J. A. (2018). Inovação nos processos de ensino e de aprendizagem: o papel das tecnologias digitais. In J. A. Valente, F. M. P. Freire. & F. L. Arantes (Eds.), *Tecnologia e educação: passado, presente e o que está por vir*. NIED/UNICAMP.

Veloso, E. F. R. & Dutra, J. S. (2010). Evolução do conceito de carreira e sua aplicação para a organização e para as pessoas. In *Gestão de carreiras na empresa contemporânea*. Atlas.

Wang, A. I. & Tahir, R. (2020). The effect of using Kahoot! for learning – A literature review. *Computers and Education*, vol. 149.

Zaluski, F. C. & Oliveira, T. D. de. (2019). A utilização de jogos como metodologia ativa: o processo de ensino e aprendizagem no ensino superior de administração e contabilidade. *Revista Temática*, vol. 15, no. 8. https://doi.org/10.22478/ufpb.1807-8931.2019v15n8.47327
