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Teachers and the curriculum in cyberculture

Abstract
This text combines theoretical reflection and empirical research on curriculum in cyberculture, and the challenges posed to teachers. This work addresses the curriculum in cyberculture based on the mobility of *online* research and teaching, with *app-learning* practices. The authors understand the process of teaching and researching based on the sharing of knowledge through the mediation of digital interfaces, conceived as devices for the emergence of curricula in cyberculture, a scenario that was consolidated with mobile technologies. In this sense, they seek to understand teachers' thoughts on the use of mobile technologies, bringing data from a study carried out in six European countries. When revealing that teachers have an important responsibility as agents of school transformation, the text concludes with a discussion on the competencies of these professionals, grounded in an informed reflection based on the exploration and experimentation of the pedagogical potential that digital technologies can offer in curricular practices.

Keywords: curriculum in cyberculture; apps-learning; mobile technologies; teachers; digital skills.

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Los profesores y el currículo en la cibercultura

Resumen
Este texto articula reflexión teórica e investigación empírica sobre el currículo en la cibercultura y los desafíos que esta impone al profesorado. El trabajo aborda el currículo en cibercultura a partir de la movilidad de la investigación y de la enseñanza en línea, con prácticas de aprendizaje mediadas por aplicaciones (app-learning). Los autores comprenden el proceso de enseñar e investigar como un compartir de saberes mediante la mediación de interfaces digitales, concebidas como dispositivos que permiten la emergencia de currículos en cibercultura, escenario consolidado con las tecnologías móviles. En este sentido, buscan comprender las percepciones de los docentes sobre el uso de tecnologías móviles, presentando datos de un estudio realizado en seis países europeos. Al evidenciar que los profesores desempeñan una responsabilidad central como agentes de transformación escolar, el texto concluye con una discusión sobre las competencias de estos profesionales, fundamentada en una reflexión informada apoyada en la exploración y experimentación del potencial pedagógico que las tecnologías digitales pueden ofrecer a las prácticas curriculares.

Palabras clave: currículo en cibercultura; app-learning; tecnologías móviles; profesorado; competencias digitales.

Os professores e o currículo na cibercultura

Resumo
Este texto combina reflexão teórica e pesquisa empírica sobre currículo na cibercultura e os desafios colocados aos professores. O texto aborda o currículo na cibercultura a partir da itinerância de pesquisas e docência *online*, com práticas de *app-learning*. Os autores entendem o processo de ensinar e pesquisar a partir do compartilhamento do conhecimento pela mediação das interfaces digitais, concebidas como dispositivos para a emergência de currículos na cibercultura, cenário que se consolidou com as tecnologias móveis. Nesse sentido, procuram perceber o pensamento dos professores sobre o uso das tecnologias móveis, trazendo dados de um estudo realizado em seis países europeus. Ao relevar-se que os professores têm uma responsabilidade importante enquanto agentes de transformação da escola, o texto termina com uma abordagem sobre as competências destes profissionais, assente numa reflexão informada e baseada na exploração e experimentação sobre o potencial pedagógico que as tecnologias digitais poderão proporcionar nas práticas curriculares.

Palavras-chave: currículo na cibercultura; apps-learning; tecnologias móveis; professores; competências digitais.

1 Introduction

In this work, we address the Curriculum in Cyberculture based on our research mobility in the areas of online education and teaching with face-to-face and cyberspace training practices mediated by app-learning and networked digital technologies. The process of teaching and researching is understood based on the sharing of narratives, images, meanings and dilemmas of teachers and researchers. Digital interfaces incorporate communicational and pedagogical aspects, as well as the emergence of a subject-group that learns while teaching and researching and teaches while learning. Online education, ubiquitous learning and their devices are configured as formative spaces for research and curricular practices in which the discursive plurality of the narratives and personal, professional and academic experiences of cultural practitioners are contemplated.

Curricula in cyberculture invite us to recognize that our authorship lies precisely in the updating of their practices in the context of teaching in cyberculture. In this sense, the curriculum in cyberculture arises from some deeply important points (Santos, 2014):

- Cyberculture is the contemporary culture that revolutionizes communication, production and circulation of information and knowledge in the city-cyberspace interface. Therefore, new *spatiotemporal* arrangements emerge and, with them, new acts and experiences of curricula. Since cyberculture is the current context, we cannot teach without effective immersion in its practices;

- Researching in cyberculture means acting as a cultural practitioner producing networked data. The subjects are not mere informants, they are cultural practitioners who produce culture, knowledge and expertise in the context of research. For us, doing research in cyberculture is not just about using *software* to "collect and organize data";

- There is no research or training disconnected from the teaching context. Our commitment is to conduct research in alignment with the teaching practice and in education that invests in cyberculture as a research field. Therefore, *online* education is a context, a research field and a training device.

- *Online* education is not a mere evolution of massive DISTANCE LEARNING practices. Therefore, we do not separate the educational contexts of cities and their cultural facilities (schools, universities, social activities, museums, organizations, scientific events, other educational networks), even more so in times of ubiquitous mobility.

The points listed above are not absolute truths and are not intended to be so. These are, however, foundations arising from our concrete experience in teaching curriculum and educational technologies in Brazil and Portugal. In Brazil, these ideas have been updated in recent years, in several projects of the GPDOC – Teaching and Cyberculture Research Group of PROPED/UERJ – Postgraduate Program of the State University of Rio de Janeiro and, more recently, at the Institute of Education of the Federal Rural University of Rio de Janeiro. In Portugal, these concepts are present in research and in teaching and learning practices in postgraduate programs at the Education Institutes of the Universities of Minho and Lisbon.

We will now present the points covered in this chapter, starting with the foundations of online education for implementing the curriculum in cyberculture, teachers' perceptions about the use of mobile technologies in learning (*app-learning*), and the skills that these professionals must develop to be able to deal with new challenges and emerging opportunities.

2 Specificities of *app-learning* and *online* education in times of ubiquitous mobility

Cyberculture in times of ubiquitous mobility has been increasingly characterized by the use of mobile devices in connection with social networking software and applications (Apps) for mobile devices. Such mobile devices (smartphones and tablets) and applications can enhance authorship in the classroom, increasing the complexity of the curricular process, making cultural practitioners authors of their own content, which is increasingly plural due to the plasticity inherent to hypermedia language that materializes with the production of images, videos, various texts and memes, among others. In this scenario, the cultural practitioner can also: invite others to participate; intervene in the

city space by raising awareness about the theme, indicating a cultural location or activity, as well as adding information (geolocation, augmented reality, recommendations); and share their own content produced online. We emphasize, however, that these possibilities demand collaborative teaching focused on the construction of knowledge in the relationship between everyone (Santos; Carvalho; Pimentel, 2016).

Online communication in the "many-to-many" dynamic has intensified greatly with the emergence of social *software*, commonly known as internet "social networks". Social *software* are interfaces or sets of integrated interfaces that structure synchronous and asynchronous communication between geographically dispersed practitioners. "Interface" is a term that, in computing and cyberculture, takes on the meaning of a device for the encounter of two or more faces in a communicative, dialogic or polyphonic attitude. For cyberculture, the interface is an *online* space for meeting and communication between two or more sides. This creates a hybrid between technical objects and human beings in communication and knowledge construction processes. In this way, practitioners come together not only to share their authorship, but also–and above all–to create social and emotional bonds for a variety of objective and subjective reasons.

In literature and in everyday life we often use the expression "social networks" as equivalent to "social *software*". This occurs because of the hybridization between human beings and technical objects. However, it is worth highlighting that social *software* serves as communication interfaces and that social networks constitute communication itself—or rather human beings in the process of communication, mediated by digital networking and its interfaces.

We agree with Recuero (2009, p. 24), for whom an internet social network is "a set of two elements: actors (people, institutions or groups; the nodes of a network) and their connections (interactions or social ties)." The expression "social network" is also not recent. According to Lemos (2010), it was created by anthropologist John Narnes, from the University of Manchester, in 1954. In the context of *web* 2.0, it is widely used to designate the interconnection of technical subjects and objects within and across the network. The concept of social networking on the internet is based on the idea of

connecting practitioners with common interests who interact collaboratively through sociotechnical mediation and their connections (Santos, 2010).

With the intense presence of mobile technologies, social networking software has taken on new formats, such as applications for tablets and smartphones (Apps). Many applications are new materials arising from the well-known Web 2.0. On the other hand, many solutions have already been created in the format (App), consequently migrating, in some cases, to Web 2.0 formats. Other solutions that were born as Apps never became a Web solution, consolidating themselves directly as applications, since mobile devices are the trend and currently responsible for the digital inclusion of many people. In our daily lives, we see children, young people and adults, and even elderly people who began their digital life in cyberculture via smartphones and/or tablets.

The term "App" is an abbreviation of "*application*", and can be offered in a free or paid version to be run directly on one or more mobile operating systems (Android, iOS, Windows Phone). Thus, mobile digital devices increasingly resemble computers in terms of available functionalities and resources.

The exponential growth in the use of *smartphone* (82%)[1] and tablets equipped with a 3G/4G digital signal via satellite and connection to local wireless networks, Wi-Fi (Wireless Fidelity), has contributed to the popularization of Apps, transposing practices carried out in collaborative interfaces accessed through the browser (Mozilla Firefox, Google Chrome, Internet Explorer) on the computer/notebook to software installed on the Operating System of the mobile digital device. It is in this scenario that we find countless applications that can be used to enhance the creativity and authorship of students, teachers and researchers in the production of narratives in cyberspace (Couto; Porto; Santos, 2016).

In classrooms, applications for smartphones, *tablets* and computers are good curricular strategies and help develop digital literacy of teachers and students. When using apps, teachers and students are fully active, transitioning from consumers to content producers, and, one might say, "producers of curricula".

[1] TIC Kids Online Research 2014.

We understand "App-learning" as learning and training processes mediated by applications in contexts of ubiquitous mobility. With this, the cultural scene invites us, as curriculum practitioners, to many challenges. Among them, we highlight the uses aimed at democratic practices, group reflection, contrasting ideas, and exchanging experiences; uses of contextualized authorship instead of technical uses; and the expansion of the possibilities of activities that bridge institutional space with other space-times, expanding the learner's repertoire and their network of knowledge and meaning thanks to the potential of ubiquity, typical of the digital network.

According to the etymological dictionary of the Portuguese language (Cunha, 2007), ubiquitous is the adjective of the Latin adverb *ubique*. The noun ubiquity comes from the French word *ubiquité*, and represents the ability to be everywhere at the same time. The term was popularized through the 1960 science fiction book Ubik by Philip K. Dick. The novel deals with dead characters who remain in a state of artificial coma and build a telepathic network with living characters (Santos; Weber, 2014).

For Souza and Silva (2006) *apud* Santaella (2013), ubiquity can be understood as an ability to communicate at any time and place through mobile devices dispersed throughout the environment, as stated:

> The concept of 'ubiquity' alone does not include mobility, but mobile devices can be considered ubiquitous when they can be found and used anywhere. Technologically, ubiquity can be defined as the ability to communicate anytime and anywhere via electronic devices spread throughout the environment. Ideally, this connectivity is maintained regardless of the entity's location or movement. This location independence must be available over too large areas for a single wired medium, such as an *ethernet* cable. Clearly, wireless technology provides greater ubiquity than is possible with wired media, especially when on the move. Furthermore, many wireless servers spread throughout the environment allow the user to move freely around physical space, always connected (Souza and Silva, 2006, *apud* Santaella, 2013, p.15-16).

Bringing the notions of ubiquitous mobility into the context of curricular practices becomes a fundamental condition for understanding how mobility, provided by wireless telematic networks and mobile devices, can be used within an educational context, providing experiences in a context of ubiquitous learning and online education, since in order to produce curricula, we have to create, manage and evaluate processes with pedagogical intentionality.

Thus, “online education” is understood as a set of teaching-learning actions, or curriculum acts mediated by digital interfaces that enhance interactive, hypertextual and ubiquitously mobile communication practices. An increasing number of subjects and subject groups, companies, organizations, in short, multi-referential learning spaces and educational networks, have been using this concept and promoting the cultural dissemination of their ideas, enhancing the democratization of information, communication and learning among geographically dispersed individuals, whether as an element that enhances face-to-face education or distance education. The digital technologies most used in current online education practices are formal virtual environments, but these are also aligned with social networking software and applications for tablets and smartphones (Apps). This convergence challenges us to structure curricular proposals in alignment with the cultural uses of digital technology already consolidated in and by contemporary culture.

We propose the use of online interfaces as platforms for online curricula. These are digital, interactive communication channels that generate new authorships and textual genres. With them, it is possible to integrate various languages (sounds, texts, and images—static and dynamic) on the computer screen, thus composing the online classroom. These online environments involve not only a set of interfaces for socializing information and teaching and learning content but also, and above all, synchronous and asynchronous communication interfaces.

We employ this classification—"content interfaces" and "communication interfaces"—solely for the purpose of conceptual organization. We call “content interfaces” the devices that allow us to produce, make available, and share digitalized content in different languages: text, sound, and image. Such formats can also be presented as an integration, that is, a mix of languages, such as audiovisual content that can merge images, texts, and sounds. These contents, in turn, can be presented in different formats, such as via hypertext, multimedia, or hypermedia (Santos, 2014).

“Communication interfaces” are generally those reserved for the exchange of messages between interlocutors in the group or learning community. These can be synchronous, real-time communication (examples: chats, web conferences, among others) or asynchronous, communication at different times (examples: forums and

discussion lists, portfolios, diaries, glossaries, wikis, among others). However, content and communication are intertwined elements; we cannot conceive of content only as information for study or curricular material constructed previously or throughout the teaching-learning process. On the other hand, we cannot deny that content is generated from the moment that interlocutors produce meanings via synchronous and asynchronous interfaces.

In this sense, we can appropriate these solutions by producing curricula in a process of authorship and co-creation. Thus, we conceive of online curricula as a living organization, in which human beings and technical objects interact in a complex process that self-organizes in the dialogic of their networks of connections. To this end, we recommend the following actions:

> **a.** Create hypertextual environments that add intertextuality, connections with other websites or documents; intratextuality, connections in the same document; multivocality, adding multiple points of view; navigability, a simple and easy-to-access environment, and transparency in information; blending, integration of various languages: sounds, text, dynamic and static images, graphics, maps; multimedia, integration of various media supports;
> **b.** Enhance synchronous interactive communication, real-time communication, and asynchronous communication; communication at any time—sender and receiver do not need to be in the same communicative time;
> **c.** Create research activities that stimulate the construction of knowledge based on problem situations, in which the subject can contextualize local and global issues of their cultural universe;
> **d.** Create environments for formative assessment, in which knowledge is constructed in a communicative process of negotiations in which decision-making is a constant practice for the procedural redefinition of authorship and co-authorship;
> **e.** Provide and encourage playful, artistic connections, fluid navigation, and simulations (Santos, 2003, 2010, 2014).

The fundamentals listed above are merely indicators for the creation of online curricula, which can inspire teachers who are or would like to interact within cyberspace, discovering and using different and fruitful ways of authorization in our time. In our experiences, we have observed a *more communicative relationship* between classic devices and interactive digital devices, since we always try to work on the city-cyberspace interface, articulating the classroom with the city's cultural facilities and the internet.

However, it is pertinent to examine what teachers think about the pedagogical use of mobile technologies (learning apps). To this end, we used the results of a European project entitled "Bringing life into the classroom: innovative use of mobile devices in the educational process" (Bento *et al.*, 2017; Monteiro *et al.*, 2017; Silva, *et al.*, 2021)[2].

3 Teachers' thoughts on the pedagogical use of mobile technologies

We begin with a brief note on the procedures used in the research to obtain information directly from the teachers involved in the project, belonging to schools in six European countries: Portugal, Greece, Italy, Poland, Romania, and Turkey (Silva *et al.*, 2021). Given the objective and characteristics of the population, it was understood that the most appropriate method would be the *survey*. The data were collected through an online questionnaire, written in each of the languages of the six countries, in addition to English, as it is the official language of the project. Then it was subject to content validation and factor validation (Cronbach's alpha of 0.713, which indicates a reasonable level of internal consistency of the items). The questionnaire was administered twice: in the initial phase of the project and in the final phase. From a population of 484 teachers, invited by email to participate in the research, 220 valid responses were obtained in the first application (45.5%) and 200 responses in the second (41.3%). For the treatment of quantitative data, descriptive statistics (frequencies and averages) were used, with the help of the JASP 8.2 software, while the treatment of qualitative data was done through

[2] BENTO, M.; SILVA, B.; OSÓRIO, A.; LENCASTRE, J.; PEREIRA, M. Trazer vida à sala de aula: utilização inovadora de dispositivos móveis no processo educativo. In: GOMES, M. J.; OSÓRIO, A. J.; VALENTE, L. (org.). Atas da X Conferência Internacional de Tecnologias de Informação e Comunicação na Educação: Challenges 2017 - Aprender nas Nuvens. Braga: Centro de Competência em Tecnologias de Informação e Comunicação na Educação, 2017. p. 459-472. Disponível em: https://hdl.handle.net/1822/47064. Acesso em: 31 jul. 2025.

MONTEIRO, A.; BENTO, M.; LENCASTRE, J.; PEREIRA, M.; RAMOS, A.; OSÓRIO, A.; SILVA, B. Challenges of mobile learning – a comparative study on use of mobile devices in six European schools: Italy, Greece, Poland, Portugal, Romania and Turkey. Revista de Estudios e Investigación en Psicología y Educación, Corunha, n. 13, p. 352-357, 2017. Vol. extra. DOI: https://doi.org/10.17979/reipe.2017.0.13.3229. Acesso em: 31 jul. 2025.

SILVA, B.; RAMOS, M. A.; LENCASTRE, J. A.; BENTO, M. Utilização inovadora de dispositivos móveis no processo educativo. In: LUPION, P. T. (org.). Ciência, inovação e ética: tecendo redes e conexões para a produção do conhecimento. Curitiba: SENAR-PR, 2021. p. 485-511. Disponível em: https://sistemafaep.org.br/wp-content/uploads/2021/06/GR.0040-Ciência-Inovação-e-Ética-Conhecimento-Livro-metodológico.pdf. Acesso em: 31 jul. 2025.

content analysis, based on the techniques recommended by *grounded theory* (Strauss; Corbin, 1990) with support from the NVivo12 software. Throughout the empirical work, recommendations on ethical procedures in Educational Sciences Studies were followed, such as voluntary participation, the right of respondents to remain anonymous, informed consent of respondents, and respect for the opinions expressed (Tuckman, 2000).

Let us now proceed to the main results of the thinking of the teachers participating in the research on the use of mobile technologies in schools and in pedagogical practices. First, we present the results arising from quantitative data.

Regarding the possession of mobile technologies by teachers, there is a clear predominance, in all countries, of cellphones and laptops. In the first administration of the questionnaire, 77.7% of teachers had a mobile phone and 62.7% had a laptop, percentages that increased at the end of the project to 83% and 74%, respectively. The study shows that most teachers have their own mobile technologies, namely mobile phones and laptops, with internet connections. Adopting the BYOD ("Bring Your Own Device") concept, there are devices that can be used for both personal and professional (school) use. Realizing that they are useful and easy to use, most teachers consider that mobile technologies have strong potential for use in schools and in pedagogical activities, and that they should be explored as pedagogical resources. Regarding the uses made of mobile phones, there is a greater incidence in: "communicating with colleagues about school matters", "managing work tasks daily or weekly", and "storing documents".

When asked whether "it is impossible to live without a mobile phone nowadays and, therefore, it should also be used at school", teachers showed many doubts, although, from the first to the second administration of the questionnaire, the percentage of "disagree or strongly disagree" dropped significantly (from 30% to 20%), and there is now greater acceptance of the idea of the vital importance of the mobile phone. However, even after a year of training, 20% of teachers disagree with the statement, continuing to think that this equipment is not vital for daily life and, therefore, not vital for school life. Considering that the sample of teachers participating in the study belongs, for the most part (around 80%), to the so-called generation of "digital immigrants", it is no surprise that there is a considerable number of people who are

resistant to the use of mobile technologies, particularly mobile phones, at school and in school activities.

The analysis of qualitative data brings us a better understanding of the factors behind this resistance in addressing the *positive and negative aspects of using mobile phones in the classroom.*

Regarding the **advantages** of using *mobile phones* in the classroom, the content analysis of the open questions in the questionnaires (initial and final) identified four categories: cognitive, methodological, socio-affective, and other aspects, each with its own subcategories.

Regarding cognitive aspects, two subcategories stand out clearly in both administrations of the questionnaire: *student information research* and *student assessment*. Based on the knowledge of the reality of the teachers involved and the type of training provided, the respondents will be referring to the use of *apps* such as *Kahoot* and *Socrative*. In the final administration of the questionnaire, the subcategories *research and knowledge construction* also stand out, which can be interpreted as a greater demand on the work carried out with students. The addition of these two subcategories may mean that teachers are now at a more advanced stage of reflection on the pedagogical use of *mobile phones* for aspects related to subject content, a topic that is always very sensitive when approaching the curricular integration of technologies.

In the methodological aspects category, there is reference, albeit with medium frequency, to four subcategories: *interactivity, autonomy and cooperation, integration of resources,* and *active methodologies*.

In the category related to socio-affective aspects, the *motivation* of students stands out in both administrations of the questionnaire, a concept expressed in statements such as: "*students show more interest in the activities*"; "*students are more involved*"; "*way more committed*". It is also worth mentioning the emergence, in the second administration of the questionnaire of a new subcategory, highlighting the potential of the mobile phone for *parental involvement*, expressed in the statement "*communicating with parents by exchanging information about what is happening at school*".

Regarding the **disadvantages** of using *mobile phones* in the classroom, the content analysis of the responses revealed five categories: cognitive, socio-affective, ethical, health, and other aspects, each with its own subcategories.

The results are clear in indicating that what worries teachers the most are the socio-affective aspects with the possibility that the *mobile phone* could provide *distraction to students*. Even at the end of the project training, around 38% of teachers continue to consider that using it in the classroom is a distraction and can interfere with school activities.

In the category of *cognitive* aspects, teachers are also concerned about some superficiality in the treatment of subjects, an aspect expressed in phrases such as: "*poor and uncontrolled use of information*"; "*carelessness, little reasoning about what they are doing*". *Ethical* aspects are also among the concerns of teachers in both questionnaires, which particularly refer to the lack of privacy expressed in opinions such as: "*they can make video recordings and share them*" and "*they may be tempted to use unauthorized images that are inappropriate for recording and dissemination*".

In the category *Other*, it is worth highlighting the subcategory on the role of the teacher as manager and person responsible for the use of mobile phones in class, despite having appeared only four times and in the same country (Portugal), stating, for example, "*the bad or good use depends on the teacher*". This position is in line with the thinking of the authors of the book "*Los nativos digitales no existen*" (Lluna; Pedreira, 2017), in the understanding that it is up to parents and educators to educate young people for a digital world.

To synthesize these teachers' thoughts on the advantages and disadvantages of the pedagogical potential of mobile technologies, we have:

- Regarding the advantages, there was a strong increase in teachers' thinking about the pedagogical potential after the training carried out during the project. Taking teachers from Portugal and Turkey (who are very well represented in the sample) as a basis, if at the beginning of the project the percentage of teachers was around 40% in each country, at the end this value rose to 72% in Portugal and 53% in Turkey. This evolution shows that training is

fundamental for transforming teachers' thinking and actions. The most highlighted advantages focus on cognitive aspects, involving *information research* and *student assessment*, *research and knowledge construction.* In relation to methodological (pedagogical) aspects, four aspects emerge: *interactivity, autonomy and cooperation, integration of resources,* and *active methodologies*. In terms of socio-affective aspects, students' *motivation* stands out.

- Regarding the disadvantages, we recall that around 38% of teachers, even after the training carried out within the scope of the project, continue to consider that this device is a distracting factor and that it can interfere with school activities. It should be noted, however, that there was a decrease in this perception: if at the beginning of the project there were 42.8% who agreed that the use of *mobile phones* could interfere with school activities, this percentage decreased to 37.5% at the end of the project. This fact makes evident the need for training, based on examples of pedagogical uses of mobile applications. In relation to the category of cognitive aspects, teachers are also concerned about some *superficiality* in the treatment of subjects: regarding *ethical aspects*, teachers refer to the lack of *privacy*; and in the category of other aspects, the indispensable *teacher's role* as manager and responsible for the use of the *mobile phone* in class is noted.

4 Regarding teachers' competencies for cyberculture

Given the challenges and opportunities that we outlined in the first part of this text and the characterization of how a group of teachers from culturally different contexts view the reality that we have designated here as Cyberculture, it seems to make sense to reflect now on the skills of these professionals (Lucas; Bem-Haja, 2021). Professionals who we assume here are holders of an important share of responsibility as agents of change and transformation of the school (Bartolomé-Pina, 2021), especially if based on an informed reflection and based on exploration and experimentation on the pedagogical and didactic potential that digital technologies can provide (Costa, 2019).

In fact, introducing technologies into schools does not automatically mean inducing new forms of teaching and learning (Papert, 1993). On the contrary, it is necessary for profound changes to take place, particularly on the part of those who are responsible for implementing the curriculum, making sense to question, therefore, what new knowledge and skills these professionals need to acquire, develop, and deepen so that the School can take significant steps in response to the challenges that technological development poses to it (Renz; Vladova; Hellmuth, 2021).

As the ultimate agents in the implementation of what the school institution offers to the students who attend it, teachers and educators end up naturally being a determining element of the equation and a fundamental pillar of the commitment that must operate with the Society in which that same School is inserted. More than following what technology already provides to ordinary citizens, the commitment will have to be mainly with reflection and discussion on what this technology and technological development can contribute to the ways in which school work is carried out (Cruz; Costa; Pereira, 2021). In other words, considering what changes can be made to the way in which teaching is usually done and how students are encouraged to learn, with what specific objectives and to develop what skills in accordance with the demands of a society that is also very different and constantly changing.

A work that stands to gain significantly from exploring the potential offered by digital technologies, for instance, in terms of new ways of organizing and sharing knowledge, the new knowledge and skills required to live in a networked environment, and closely interacting with others in a fully connected global world—in short, in a radically different world, like the one we already have the opportunity to observe and experience today (Siljebo, 2020).

Despite the fact that for about a century, in one way or another, the transformation of the School through technology has been announced, and there has never before been such proximity between the demands of the School and the capacity of technology to respond to them (Laurillard, 2002), observation of reality shows that, in the name of progress, the established culture often seems to try to make new media serve the same purposes as the old ones (McLuhan, 1964). A phenomenon that Petraglia (1998) called the "domestication of technology" and which is nothing more than its

conceptualization associated with and naturally subjugated to traditional pedagogical concepts and practices. In other words, a reductive perspective, which does not offer many opportunities to consider what could be done differently and, as a result, ends up limiting the exploration and achievement of new horizons in the formulation of learning objectives and personal and social development of individuals. This reduces the contribution that digital technologies can make to the teaching and learning process while also limiting the perspective of how professional teacher training in this area has been considered and implemented.

Perhaps it is at this crossroads that teachers, along with those who train them, find themselves. It may be useful to bring here some of the key ideas that we have been working on and that may in some way help these professionals to take the transformation of the School into their own hands. A transformation of the school that could begin by considering three core axes that, in our opinion, are decisive:

i. exploration of the potential of technologies as a learning tool and not, as has been predominant, as a teacher's tool at the service of a knowledge transmission strategy;

ii. exploration of the stimulating effect that this type of use, from a curricular perspective, can bring in terms of a new learning culture; and, finally,

iii. analysis and evaluation of the impact that, in turn, this new reality may have on the relevance and enhancement of the school's role in the development of the society in which it is embedded.

Necessarily, with a reflective and investigative perspective on how this can drive innovation and change long-established teaching and learning processes, it is crucial for teachers to understand not only what to do and how to do it, but also what it will mean in terms of personal investment, professional development, and their relationship with knowledge, themselves, and the world around them (Lima; Castro, 2014).

As we have discussed elsewhere (Costa, 2009), the new technological contexts shaping our daily lives today offer a significant opportunity for teachers to reflect more deeply on the use of these new means of accessing and constructing knowledge in schools. Teachers need to consider why these technologies are being used, what actions

to take, when, and for what specific purposes. From this understanding, they can chart the necessary path, including the personal and professional investments required and in which specific areas, to provide students with experiences in environments enriched and stimulated by computers and the Internet, ultimately fostering meaningful learning.

As is the case in most professions, reflection on the set of skills required to take advantage of these new learning environments is essential and should be part of the concerns of every teacher as a professional, especially because the training they have been provided with is admittedly insufficient and unsatisfactory, particularly with regard to the integration of these powerful instruments into the curriculum. As some studies conclude, this is a type of training in which learning tools are valued above all, most of the time without any connection to school objectives and without the possibility for teachers to try them out in the classroom (Vrasidas, 2015).

Hence the importance of a structured and consistent intervention in terms of the work to be developed with these professionals, such as that proposed in Portugal in 2008 in the context of the Technological Plan for Education (Costa *et al*., 2008, 2009). This is a proposal with guidelines regarding teacher training for the use of information and communication technologies in a curricular context, which had precisely as its horizon the encouragement of innovation in pedagogical practices, from an investigative perspective and based on the sharing of experiences and collaboration with the different stakeholders in the educational community. A proposal that, in addition to teachers' mastery of basic digital skills, envisaged an intermediate level in which each teacher is expected to develop skills related to the integration of technologies into their practices as a pedagogical and didactic resource, that is, at the service of developing differentiated teaching and learning strategies that are different from what is usually done without them, with a view to improving students' learning.

As stated in the justification of the proposal, it is a skills reference that can be taken "as a basis for reflection and support for the professional development of teachers, as it facilitates the process of analyzing individual and institutional training needs, decision-making on training processes and paths, investment guidance, evaluation of results, and investigating changes in practices or improvements in the school system." (Costa *et al*., 2009, p. xv). A framework created taking into account the Portuguese reality

(although benefiting from the knowledge of other international references studied), whose main purpose was to stimulate the exploration of the potential of the new technologies to which we have been referring in this text, and which, in practical terms, delimits the set of macro skills that any teacher is expected to be able to develop.

Within this framework, it is specifically assumed that, in order to effectively carry out their professional activity in a school in tune with the technological development of society, the teacher:

i. Has up-to-date knowledge about technological resources and their potential for educational use;

ii. Follows technological developments as they relate to the teacher's professional responsibility;

iii. Performs operations with hardware and operating systems (using and installing programs, solving common problems with the computer and peripherals, creating and managing documents and folders, observing security rules in compliance with legality and ethical principles, ...);

iv. Accesses, organizes, and systematizes information in digital format (research, select, and evaluate information based on specific objectives ...);

v. Performs operations with online and/or offline programs or information systems (accessing the Internet, searching databases or directories, accessing reference works, ...);

vi. Communicates with others, individually or in groups, synchronously and/or asynchronously through specific digital tools;

vii. Prepares documents in digital format for different purposes and for different audiences, in different contexts;

viii. Knows and uses digital tools to support assessment and/or research processes;

ix. Uses the potential of digital resources to promote their own professional development from a lifelong learning perspective (diagnoses needs, identifies objectives);

x. Understands the advantages and constraints of using ICT in the educational process and its potential to transform the way we learn.

This set of macro-competencies may also serve as a basis for broader reflection and discussion about the school we have—and the one we want—for the 21st century, although it is clear that a teacher's simple awareness of technological possibilities is not enough.

5 Final considerations

Throughout this text, we seek to reflect on the challenges that current ICT poses in curriculum development and the consequent challenges to teachers due to changes in the acts of teaching and learning.

It is unquestionable that we are living in a time of accelerated technological innovation that allows the deepening of cyberculture, a "mobile and ubiquitous cyberculture", thanks to the development and widespread acceptance of mobile communication devices, namely *smartphones* and *tablets*, adapted to broadband internet, making information accessible anywhere and at any time.

Several studies tell us that there is an increasing acceptance of mobile devices by people, particularly young people who have developed a genuine "love affair" with these technologies, with personal cell phones being seen as a means of being "*online*", reachable at any time (Pereira; Silva, 2008). Cardoso *et al*. (2015), in a study with national coverage (Portugal), found that in the decade 2003-2013, the Internet/mobile phone interrelationship became increasingly important and that the use of the Internet from mobile devices is particularly relevant among younger individuals, specifically those aged 15 to 34. This observation led psychologist Daniel Sampaio, in a book entitled "From the Mobile Phone to the World", to state that:

> Young people are the most active inhabitants of this new Galaxy, and sometimes they even glorify it excessively. The reality is that teenagers are not capable of living without the internet, and it is good that parents and teachers are convinced of this (Sampaio, 2018, p. 34).

Naturally, education and schools cannot be distanced from these 21st century cybercultural scenarios. Mobile and ubiquitous cyberculture has been increasingly characterized by the use of mobile devices in connection with social networking software and learning applications, known as App-Learning. Such devices can enhance the complexity of the curricular process by empowering cultural practitioners to become authors of their own content. This authorship is increasingly plural, driven by the plasticity inherent in hypermedia language, which manifests through the production of texts, images, videos, and other media forms. Curricular action has in current ICT a strong ally to enhance interactive and hypertextual communication practices, creating a true "interactive classroom" (Silva, 2012).

Bringing the notions of ubiquitous mobility into the context of curricular practices becomes a fundamental condition for understanding how mobile devices can be used to provide educational experiences in the context of online education and ubiquitous learning. As we stated in the text, it is not the online environment that defines curricular acts. The environment influences but does not determine outcomes, as everything will depend on the pedagogical actions of the cultural practitioners (namely teachers and students) involved to guarantee the co-creation of curricular processes. We therefore understand that teachers, as the ultimate agents in the implementation of what the school institution offers to students, end up naturally being a determining element of the equation and a fundamental pillar of the commitment that must operate with the Society in which this same School is inserted.

It is therefore essential to understand what teachers think about the use of mobile technologies in schools and in pedagogical practices. This finding comes from a study conducted across six European countries, as mentioned earlier in the text. The study revealed that most teachers own mobile technologies, recognize their usefulness and ease of use, and see strong potential for integrating them into school and pedagogical activities. Consequently, they believe these technologies should be explored as valuable pedagogical resources. They recognize several advantages of using mobile devices in the classroom, namely *mobile phones* (*smartphones*), highlighting the "cognitive" aspects regarding *information research*, *student assessment*, *research* and *knowledge construction*. However, there are significant references to the disadvantages of using mobile devices in

the classroom, particularly concerning socio-affective aspects. This includes the potential for these devices to cause *distractions* among students and *disrupt* school activities.

These reasons have led to the use of smartphones in schools being banned in many countries. We know what happened from late 2019 onwards with the COVID-19 pandemic, which led to the closure of schools in 2020 and much of 2021 (as well as most societal activities), shifting teaching and learning to remote and distance modalities. Looking back, if instead of banning smartphones, a program had been implemented to integrate this technology into pedagogical practices, the transition from face-to-face to remote teaching could have been much more effective. Having already developed skills in using these handheld computers for educational purposes, both teachers and students would have been better equipped for the shift to remote learning. This is one of the lessons to be learned from the effects of the pandemic on school education (Silva; Ribeirinha, 2020). The smartphone offers such versatility that it enables teachers to create a true "interactive classroom," as Marco Silva describes, whether the setting is in-person, online, or hybrid (Silva, 2012). As Dias Figueiredo points out in a post-pandemic project assessment, the smartphone, in addition to allowing oral communication, is:

> [...] book, dictionary, encyclopedia, library, camera, photography lab, video camera, film studio, classroom, graphic arts workshop, text and image scanner, newspaper editorial office, meeting room, museum, scientific and graphic calculator, mathematical environment, database management system, word processor, spreadsheet, communication tool, measuring instrument, simulator, biological data meter, animal, plant, and mineral identifier, disease diagnosis, map, atlas, compass, GPS locator, navigation tool. The list is endless! (Figueiredo, 2021, p. 255).

Teachers play a vital role in school education in several aspects, but especially in curricular activities that take place in classrooms, an aspect also highlighted in the empirical study when, regarding the use of mobile devices, they state that “whether they are used well or poorly depends on the teacher”.

Therefore, we believe it is important to bring up for discussion, at the end of the text, the issue of teachers' skills, because, as Seymour Papert already stated in the mid-1990s, introducing technologies into schools does not automatically mean inducing new forms of teaching and learning, and it is necessary to question what new knowledge and

skills are necessary for schools to be able to take significant steps in response to the challenges that technological development poses.

Rather than following what technology provides to ordinary citizens, the commitment will have to be, mainly, with reflection and discussion about what this technology and technological development can bring to the ways in which school work is carried out. That is, considering what changes can be made to the way in which teaching is usually done and how students are encouraged to learn, with what specific objectives and to develop what skills in accordance with the demands of a society that is also very different and constantly changing.

Hence the importance of a structured and consistent intervention at the level of teacher training for the use of ICT in a curricular context, from a research-training perspective in teaching practice, based on the sharing of experiences and collaboration with the different stakeholders in the educational community, with the aim of encouraging innovation in pedagogical practices.

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