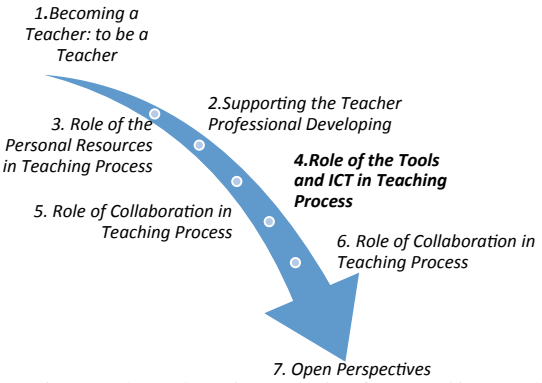
Chapter 4
Role of Digital Tools and ITC in Teacher Practices

Abstract In this chapter, the concept of appropriation, tools and scripts is introduced, with a research example of teachers' appropriation of iPad in the classroom. Then, the perspective of socio-materiality is here considered as a framework to analyse teaching practices. Research is presented about ITC social and material appropriation, focusing on artefacts in a socio-cultural approach. Critical views of educational technology are useful considering the impact of global crises, as the Covid-19, asking for questioning traditional curricular theories.

Keywords Appropriation · Tools · Scripts · Socio-materiality · Artefacts · Curriculum



During teacher education, ICT is often used in a traditional pedagogical setting, rather than to help with the construction of students' knowledge. Consequently, student-teachers' experience of using ICT pedagogically is somewhat limited. Thus, once in service, future teachers tend to reproduce the same uses (Koh & Divaharan, 2011), or to add technology to traditional learning methods only. It appears that only after several years of experience do teachers begin to incorporate more critical approaches to the integration of technologies.

In this chapter, the concept of appropriation, tools and scripts is introduced, with a research example of teachers' appropriation of the iPad in the classroom. Then,

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the perspective of socio-materiality is here considered as a framework to analyse teaching practices. For this, research is presented about ICT social and material appropriation, focusing on artefacts in a socio-cultural approach. Critical views of educational technology are useful considering the impact of global crises, such as Covid-19, asking for questioning traditional curricular theories.

4.1 Appropriation, Tools and Scripts

The teaching professions require a broader and sophisticated set of competences. Digital devices are ubiquitous and open a new path. Europe proposes the European Framework for the Digital Competence of Educators (DigCompEdu) to orient toward digitally competent teachers. The model is directed towards all scholastic levels of educators, including vocational special needs education, and non-formal learning contexts.

Technology integration is a broad topic of discussion in education. It is possible to find different levels of integration and use of technology by teachers.

The teaching subject is considered an internal factor that influences teachers' perceptions of digital technologies' value (Orji, 2010). However, the teaching and learning effects of ICT depend also on how educational technology is used (Bielaczyc, 2006). For this, it is crucial to understand and limit the barriers that schools and teachers encounter during appropriation and use of ICT.

Different approaches have been developed to describe and analyse various teachers' processes of technologies' appropriation regarding acceptance, rejection and use of a device in educational contexts. Adopting new technology is typically performed through replacements and transformations. Many schools have completed the replacement stage, which entails to take an existing resource and replace it with a relatively similar new digital aid. On the contrary, transformation occurs when a process or a resource is wholly changed, implying a learning method's rebuilding process. The appropriation notion is employed when the user begins to use the artefact in their environment until a fruitful utilisation. Jones and Issroff (2007) defined the appropriation in terms of how a particular technological artefact is adopted and shaped in use.

The appropriation process also includes aspects concerning the mutual influence between the technology and the users (Overdijk & van Diggelen, 2008), with a simultaneous transformation process, including the learner and the tool. This mutual shaping process between the device and the subject recalls an instrumental approach (Rabardel, 1995), based on the distinction between artefact and instrument. An artefact is an object of the human activity that has been designed for specific activities. The user builds and develops some cognitive structures (the schemes) using the artefact to carry out a task. An instrument is a mixed entity: according to Rabardel (1995), the instrument is constructed through an instrumental genesis, a bilateral relationship between the tool and the subject. The teacher makes choices in their usage of the

device within the educational practice by 'adapting' it in goal-directed activity. At the same time, technology gets its form and meaning during social interaction.

According to an ecological perspective, the process of appropriation is interactive. It implies the assimilation and the accommodation, as well as changes, the possibility to adapt the technological device to fit personal, interpersonal and social-cultural requirements. Indeed, the success of new technology is determined by human factors that mediate the adoption and its use.

The teacher education institutes give more responsibility to an adequate technical education level for future teachers or teachers already in service. Indeed, the development of technological expertise is considered a priority for future teachers.

Finally, introducing any new technology in an academic institution generates tensions between an old system of working and the new one, which need to be accommodating and assimilated by all the community involved. At the same time, the students, the teachers, and all the school administration, supported by the ITC office or researchers, have to make sense alone and in a group of the new technology, finding a unique opportunity of learning and action. In this end, human factors mediate success in the adoption and the use of technology.

4.2 Socio Materiality in the Teaching Process with ITC

Schooling is a specific practice of learning by designated spaces in which agents use particular tools for educational purposes, simultaneously in the ontological time-space of their classroom (Hamilton & Zufiaurre, 2014). New technology came to challenge this traditional setting. Together with augmented reality and social robotics, one of these is the virtual reality system or Virtual Reality (VR) and social robotics. Indeed, the change in educational setting derived by the introduction of new technology has only recently been investigated regarding how people discursively arrange the context of their activity spatially and temporally. For this, an interesting perspective to analyse the change caused by the introduction of technology is the socio-materiality perspective.

The socio-materiality perspective addresses tools, artefacts and language as part of human actions that create meaning in a social dimension that is inseparable from the classroom interactions (Cabello et al., 2019). The learning materiality is distributed relationally (Sørensen, 2009). This relational materiality is often overlooked in educational research, dismissing how space is represented in artefacts such as diagrams or images constructed in educational practices.

In socio-materiality, a central role is given to the language. Indeed, teachers and students are involved in continuing explanation and interpretation of tasks in the learning environment. For example, virtual reality introduces and could transform teaching practices with new modality and an extended simulated setting. Considering the change in the context's configuration due to the introduction of virtual reality in an educational task, students and teachers need to make sense and negotiate the spatial and temporal here-and-now of the activity. The process of sense-making is

considered a ubiquitous process of making the "ever-new moments" of experience "familiar, understandable and even predictable" (Martsin, 2012).

The socio-material perspective also englobes the reference to the body. The embodiment concept has gained currency in recent years, particularly in light of new forms of interaction and engagement with emergent technology. This perspective offers rich reflections for conceptualising the relationship between the body's physical actions and meaning-making processes.

In a socio-material perspective, the spatial and temporal dimension is also important. Researchers have recently begun to explore the spatial dimension of classroom discourse (Ehrenfeld & Horn, 2019), expanding from an analysis of language alone to the analysis of multiple modalities to describe the situated nature of teaching practice. The work of Shapiro, Garner et al. (2020) visually and dynamically explores the spatial and temporal dimensions of classroom discourse. This work sees the application of the methodology called "Interaction geography" as an integrative and multiscalar approach to studying how participants' physical movements can be embodied resources for sense-making and learning in a physical environment (Shapiro et al., 2017).

***A theoretical Focus*: The Artefact in the Sociocultural Approach** Artefacts are elements of mediation between individuals and the world, changing their experience and their cognitive processes (Cole, 1996). Artefacts are elements of mediation between individuals and the world, giving new meaning to the flow of the experiences. Artefacts are a process of communication between the subject and others around an activity, the externalisation of knowledge (Bruner, 1990). The concepts of mediation and artefact are crucial in the Vygotskian perspective. This concept postulates that humans do not have direct access to reality, but that they need mediation tools. The ability to influence the psychological structure remains an essential function of mediation instruments, which are renamed artefacts just to emphasise the fact that they are not objects given in nature, but are the facts with art; these interact and at the same time shape the mental processes of those who built and used them. Examples of artefacts are the language, digital systems, works of art, diagrams and maps, with a social and psychological role. Indeed, artefacts are externalised in the form of mental processes. The manifestation of mental activity occurs on two levels: the material tool used to carry out a particular activity; a psychological level, internalised when the action becomes symbolic. So, in the first level, we learn how to use a specific tool, and subsequently, we internalise it; that is to say, for example, first the focus is on learning to use a pen to write, then thinking about the writing activity without thinking about how to use the pen.

In summary, artefacts mediate our actions on the world and therefore determine psychic processes. Therefore, the invention of a new artefact is a form of objectification of a new approach, which is then shared and socialised in a community, making possible renewed processes of creation. Artefacts are the

results of a communication method between an individual and others around an activity. Indeed, the design of complex artefacts requires more knowledge than one person alone can possess. So, in a community, it is possible to use multiple points of view and argumentation to design complex artefacts. Recent attention to design learning contexts focuses on creating concrete knowledge objects (e.g., reports, models, scheme, maps, figures or videos). They are derived from collective participation of all community members, putting in joint efforts and resources.

4.2.1 From the Research*: Social and Material ICT Appropriation*

It is essential to determine the conditions necessary for the use of technology in teachers' education to bring positive and profitable results in student-teachers' progress, like exploring the perception and the use of educational technology. For example, in the French context, Impedovo et al. (2016) propose a discussion of the five categories that emerged from the analysis of ITC appropriation by teacher educators in a school of education: prescriptions versus personalisation of ICT tasks; technical versus pedagogical ICT teacher educators' education; required use versus student-teachers' ICT skills; technical features versus subjective resistance in online learning environment use; and issues in the use of the ITC. The categories are in Fig. 4.1.

In the following, the four categories are analysed.

a. *Prescriptions versus Personalisation of ICT Tasks*: the results show the difficulties in translating the national directives into the practice of teacher education. The implementation has required resources and coordination for the ICT tasks organisation. Rey and Coen (2012) considered that most teacher-education institutes rarely base their technological decisions on specific published research findings. Instead, they often start by thinking about the intended results that

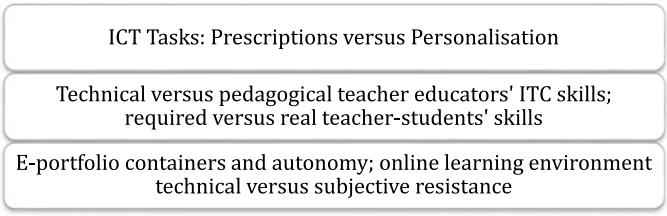

Fig. 4.1 Contrastive categories' axial coding of ITC appropriation (Impedovo et al., 2016)

technology should provide within their school environment. So, it has been found that the use of ICT is below initial expectations.

b. *Technical versus pedagogical teacher educators' ITC skills; required versus real teacher and students' skills*: this emphasises the necessity of providing specific ITC education for student teachers, especially in the first year of their master's course. Indeed, even if they are considered "digital natives", teacher-students don't have all the necessary knowledge, skills, and attitudes to use educational ITC correctly. Although equipped with advanced computer skills, student-teachers find different difficulties in using educational technologies, especially when there is a lack of vision about their usefulness in professional practice. Understanding the dynamic between technological expertise and academic discipline also reveals an essential factor in integrating ICT.

c. *Containers and autonomy of the e-portfolio; technical versus subjective resistance of the online learning environment*: for teacher-educators and teacher-students, the ePortfolio and ITC technology were not yet "light and invisible", considering the technical difficulties involved in its integration and appropriation. Sometimes the use of educational technology shows a degree of "unwillingness to change" (Lasky, 2005, p. 913). A slow process of adoption leads to meshing new ideas with well-established beliefs and practices.

4.2.2 In the Practices*: The Case of the iPad*

The value that iPad entails in education is widely discussed (Murphy, 2011). The integration of iPads in the classroom requires efforts in terms of adaptation to reach qualitative changes (Jones & Issroff, 2007).

Various studies have documented forms of teachers' rejection or low-level use of new technology despite the availability of tools in the classroom. The traditional education courses for pre-service or in-service teachers do not provide specific learning skills to manage an adequate appropriation of new technologies.

As an example, we propose a study focused on teacher iPad appropriation (Boéchat-Heer et al., 2015, 2019). The authors focused on comparing two teachers' focus groups on analysing the appropriation process of the iPad.

The process is summarised in Table 4.1.

The teachers' voices highlight the specificities of the research experience, recognising the complexity of the appropriation.

The study shows that iPads bring new possibilities to the learning environment. However, the analysis reveals that teachers use digital tablets to support their academic activities, without a real change of their usual teaching practices (Jones & Issroff, 2007). The classroom configuration does not change; the students are not involved in networking activities; each pupil is behind his/her desk, more or less, as is the case during a traditional lesson.

The introduction of technology in education has to be considered concerning the institutional culture. Moreover, if the institutions promote innovation through

Table 4.1 Summary of the four dimensions about iPad appropriation (Boéchat-Heer et al., 2015)

	Dimensions	From	To
I	Management of technical features	Technical features	The social shape of the iPad's use
II	Management of socio-relational aspects	Individual perspective	Collective appropriation
III	Management of didactical and pedagogical aspects	Tools	Instruments
IV	Management of subjective strategies	Resistance	Engagement

sharing, teamwork and accepting the related risks, teachers will be more likely to engage. Indeed, as reported in the study, teachers' professional expertise about ITC can be improved if teachers are continuously involved in sense-making processes for their activities, for example, through negotiation and discussions between them.

4.2.3 The Idea in Brief*: Covid-19 and Materialized Reflection*

Since the spring 2020 semester, the Covid-19 pandemic has been spreading throughout the world. The epidemic caused shutdowns to schools and universities. The immediate change imposed on the world by the Covid-19 epidemic forced all educators to act and react with urgency. The hunting for the best digital tools began, in particular for video meetings. The necessity of integrating technology creates opportunities for educators to examine their work and how different tools and resources can enhance learning (Ruggiero & Mong, 2015). The rapid switch to online learning required a profound rethink of everything about courses, such as a discussion about ITC integration and appropriation.

4.2.4 Professional Insight*: Post-critical Curricular Theories*

The emphasis on efficiency and administrative rationality, espoused by traditional education theories, would reflect the domination of capitalism over schooling and curriculum, thus contributing to the reproduction of class inequalities. To advance an education rooted in social justice requires a move toward critical awareness. The teachers become aware of education's politics and recognise that education is not a neutral process (Freire, 2000). Technology, digital resources, software, online application etc. are not neutral either.

Critical views of education call into question the assumptions of existing social and educational arrangements to the aim of subjects' emancipation. So, teachers and students can express their voice and become aware of social structures' control and power. The implication is a multicultural curriculum based on the ideas of tolerance and respect (Lopes & Macedo, 2011).

Post-structuralism and postmodernism perspectives focus less on matters of power to discuss the whole modern Western philosophical and scientific tradition. Teachers are invited to take ownership of the different forms of reading and interpretation of reality, going beyond technical rationality. For example, Rezende and Ostermann (2020) provide some in-depth analysis of teacher training curriculum in Brazil to consider the social reality and pay attention to real students of Brazilian public secondary schools: "young people living social and productive relations marked by exclusion, by the lack of future project, by technological complexity and the media" (Kuenzer, in Rezende & Ostermann, 2015). Another example is proposed by Boone (2020) about how Brazilian black women experience double oppression—race and gender: "The early childhood education profession primarily consists of female teachers which historically has been informed by the perspectives of white males". Black women teachers' every day active involvement in social change and activism produces risks like challenging authority and avoiding compromising. A new relationship with knowledge could mediate a new understanding of experiences and practices:

> "The teacher does not possess education as an object. Education is not a possession of this sort. The teacher can only bear witness to the truth of education. (…). The Teacher is like Moses: they set the captives free but cannot enjoy the same freedom for themselves. (…). The teacher is at most a student". (Rocha, 2020)

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