# Chapter 4
# Sociocultural Perspectives on Creativity, Learning, and Technology


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**Abstract** In this chapter we focus on the links between creativity, learning, and technology in education. More specifically, we propose and exemplify a unitary, sociocultural framework of creative learning based on the notions of position and perspective. We start by specifying some general principles of sociocultural theory, in particular the interdependence between person and context and the way in which psychological processes "extend" into the world through the means of action, interaction, and communication. Following this, we outline the perspectival model of creativity and learning, focused on how re-positioning and perspective-taking lead to new, creative insights, and relate it to various uses of technology in education, including technology mediated creative learning practices and immersive technology. In the end, we reflect on the consequences of these uses for how we understand, theorise, and cultivate creative learning in and beyond the classroom.

## 4.1 Introduction

What would education be like for students if, during class, teachers were to show more of what they are talking about? For example, when discussing the lives of people in ancient Rome, students could experience what it was like to walk the streets of Rome at the time. Or, in geography class, they would see what the view from the top of Mount Everest looks like or find themselves in the middle of a herd of dinosaurs when covering paleontology. Of course, these experiences are all possible in the classroom, to varying degrees. Teachers have long been using all sorts

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of tools—from images and models to written texts—as resources for igniting students' imagination and opening new possibilities for learning and creativity. Nowadays it is more common to use videos in the classroom in order re-position students within other spheres of experience (Zittoun & Gillespie, 2016). The reliance on multiple cultural tools in education is something Vygotsky (1978), a founding father of sociocultural theory, advocated almost a century ago. The technological advances that revolutionise so many segments of our lives are slow to be adopted by educators for a number of reasons, though, from fearing their disruptive potential and not mastering them sufficiently, to a lack of support and financial resources. Yet, the virtual world and its technological underpinnings are gradually entering not only students' lives but also their school lives and, in the process, create a new context for education that needs to be examined further.

An important question is how these new technologies shape creativity and learning, and why. We focus on links among creativity, learning, and technology in this chapter because they are at the heart of a sociocultural approach to education. This approach starts from the premise that creativity, or the process leading to the emergence of meaningful novelties, is in fact a distributed phenomenon, one taking place "in between" rather than "inside" the mind (Glăveanu, 2014). "To create" involves, fundamentally, collaborating with others either in an implicit or explicit manner. One can collaborate with others directly by working in groups or exchanging with teachers and peers. But, at a deeper level, students (and teachers as well) collaborate with the ideas or points of view of others who in many cases are no longer living but have left their mark on culture or society. There is, in this sense, a strong connection between learning and creativity because, in order to create, the person needs to acquire new experiences of the world and to learn from them.

Creative learning is, from a sociocultural standpoint, a rather tautological expression. We create based on what we know and thus have learnt. At the same time, we learn by appropriating and transforming content, recreating it to various extents so as to understand and use it, rather than simply replicate it inside our head. Moreover, culture and its symbolic and material tools mediate both these processes, standing as the two faces of the same coin. Technology, from simple pen and paper to the virtual reality sets of today, is a key mediator of creative learning given its capacity to expand our experience beyond the "here and now" and towards the absent and the possible.

In this chapter, we discuss and illustrate these links within a unitary, sociocultural framework of creativity and learning based on the notions of position and perspective. We start by outlining some general principles of sociocultural theory. In particular, our focus is on the interdependence between person and context and on the way in which psychological processes "extend" into the world through the means of action, interaction, and communication. Then we outline a perspectival model of creativity and learning, relating it to various uses of technology in education, including technology mediated creative learning practices and immersive technology. In the end, we reflect on the consequences of these uses for how we understand, theorize, and cultivate creative learning in and beyond the classroom.

## 4.2 Sociocultural Approaches to Creativity and Learning

In past decades, creativity and learning became two highly popular concepts in science and in public debates about society and education, as well as business. Creativity and learning are assumed to underlie knowledge-based economies and learning societies (Hargreaves, 2000), and are part and parcel of what became known as twenty-first century skills (see Trilling & Fadel, 2009). Despite this surge in popularity, however, most scientific theories of creativity and learning still reflect the behaviourist and cognitivist legacy of the twentieth century. In particular, they start from the all too often implicit assumption that both these phenomena are "located" within the mind or, in more recent research streams, the brain of the person who learns or creates. For as much as it aids the development of psychometric instruments, this radical individualisation is incongruous with today's practices of both learning and creativity.

Connectivity and collaboration are at the core of how children and adults learn and express their creativity. This is supported by the use of technology and other similar tools to communicate, share, and transform cultural content. The distributed nature of creativity and learning in the age of the Internet (Literat & Glăveanu, 2016) calls for new conceptual frameworks, forms of measurement, and intervention. Most of all, it requires us to think and study these phenomena in a systemic, relational, and developmental manner, being much more sensitive to context and process instead of simply focusing on person and product.

A conceptual framework apt for studying these phenomena is the sociocultural approach most commonly connected to the work of Lev Vygotsky. He made important contributions to both psychology and education and is often seen as one of the founding fathers of sociocultural theory. Following a Vygotskian approach, creative processes are inherently social, as ideas develop through a combined and relational process of co-construction of meaning and knowledge enhancement through dialogue. This theoretical positioning is grounded in the three main premises of the sociocultural approach, as identified by Wertsch (1991):

1. individual development originates in social sources, whether cultural or historical,
2. human action, at once individual and social, is mediated through tools or signs,
3. these processes span time and space.

In this chapter, in particular, we pay attention to the Vygotskian view that cultural resources (tools and signs), acquitted and employed in interaction with others, mediate our action and contribute to our development. Such a sociocultural perspective on creativity and learning (Glăveanu, Gillespie, & Valsiner, 2015; Lave & Wenger, 1991) offers a cutting edge scientific perspective that is critical of theories that "place" both these phenomena inside the mind of isolated individuals and treat them as static. It postulates a dynamic, distributed, and participative view in which creativity and learning develop within relationships and are mediated by the use of cultural tools, including technology.

Vygotsky saw semiotic mechanisms as mediating social and individual functioning, and connecting the external and the internal, the social and the individual (Wertsch & Stone, 1985). He stated that human action, at both an individual and social level, is mediated by tools and signs. Such tools, often referred to as "psychological tools" (Wertsch, 1991, p. 28), include language, systems of counting, mnemonic techniques, algebraic symbol systems, works of art, writing, schemes, diagrams, maps and mechanical drawings, conventional signs, and so on. According to Wertsch (2007), our contact with the social and physical world is not direct and unmediated but rather indirect or mediated. In our contact with our surroundings, we are making use of semiotic and psychological tools in particular. All mediated activities involve the use of psychological tools, which first existed outside the person and gradually became internalised or appropriated, regulating individual thought, emotion, and behaviour (John-Steiner & Mahn, 1996; Vygotsky, 1986).

According to this sociocultural view, semiotic mediation is important for all the processes involved in creativity and learning activities. Thus, creativity and learning are two psychological processes that could benefit greatly from a sociocultural approach. This is because both of them are shaped by interactions. These interactions can take place with other people as well as between people and their material environment, which includes both appropriated and transformed cultural resources. Although treated separately in most cases, there are many links between creating and learning, as explained above.

These links prompt researchers today to talk more about "creative learning," which we will define shortly. In fact, from a sociocultural perspective, acts of creativity always involve an element of learning—either about oneself, about others, or about the world—whereas learning is in itself a creative process, leading to the generation of new perspectives and knowledge for the learner. Here, we elaborate a unitary theoretical framework for creativity and learning, one that is grounded in the notions of difference, positions, perspectives, and reflexivity and considers the social and material conditions necessary for creative learning to occur.

All sociocultural research starts from the premise of the interdependence between mind and context and proposes the cultural (symbolic and material, including technological) mediation of human action (Shweder, 1991). From this perspective, *creativity and learning are both situated cultural activities that lead to the generation of new and meaningful perspectives in relation to particular contexts or problems*. In fact, from this standpoint, there is little difference between learning and creativity. The reason is that both phenomena build on the creator/learner's experience of the world in ways that produce new knowledge, tools, or practices for the person, the group, and sometimes for society. The view that creativity and learning feed into each other has been recently supported (see Beghetto, 2016). Creative learning stands at the core of what defines human beings as active agents, rather than passive recipients, of existing cultural content.

Beghetto (2016) states that when students are engaged in learning, they construct their understanding of what is being taught by combining what they already know with the new experience. The combinatorial process is a creative process in which the whole has new properties compared to the parts. In the case of learning, the

process of integrating prior knowledge with new experience results in a change in personal knowledge. In this way, change serves as a common link between learning and creativity. *Creative learning* can be defined as "a combination of intra-psychological and inter-psychological processes that result in new and personally meaningful understandings for oneself and others" (Beghetto, 2016, p. 4), a working definition we also adopt in this chapter.

Creative learning is, in other words, mediated human action and a psychological process. This mediated action involves what Vygotsky (1978) refers to as Zone of Proximal Development (ZPD), which is a means of explaining how social and participatory learning take place (John-Steiner & Mahn, 1996). ZPD has been defined as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Given these processes, human beings are not passive recipients of knowledge; in fact, the ZDP is grounded in activity and interaction. According to Newman and Holzman's (1999) explanation,

> For Vygotsky, human development was revolutionary activity—development (more properly developing) is inseparable from creating environments for development. The social-cultural-historical process of creating what he called ZPDs is the revolutionary activity of people jointly (collectively, socially) transforming totalities. ZPDs are not instrumental means-ends tools for results, but simultaneously prerequisite and product, tool and result. (p. 100)

A constant negotiation between the learner and the more advanced partner takes place in the ZPD. Its outcomes are never a given, deriving from a form of scaffolding that is prefabricated (see Daniels, 2008; Newman, Griffin, & Cole, 1989). Creative learning has this kind of active negotiation and shifting of perspectives at its core. When we follow this line of thought, we see how technology, in a proximate development zone, represents an essential factor by enabling learners to explore a variety of positions and perspectives available within their environment. Technological tools thus mediate both creativity and learning in the relationship among people, groups, and organisations. A question is, why and how is this the case?

## 4.3 A Perspectival Model of Creativity and Learning

As described in the previous section, the sociocultural approach is based on a set of assumptions that help connect creativity and learning. First, sociocultural theory assumes that people participate in culture as active agents, not simply acquiring and reproducing, but appropriating and transforming cultural elements (Vygotsky, 1980). This dynamic can be conceptualised in terms of learning and it is a *bi-directional process* in which individual and context shape each other (Valsiner, 2014).

Second, this is a socially mediated process that builds on explicit or implicit interactions with other people, from teachers to colleagues, competitors and critics.

It is by being able to take the perspective of others (i.e., to see ourselves and the world as another does) and learn to share and coordinate perspectives or points of view that we develop a human self (see Mead, 1934). By so doing, we become capable of acting flexibly and creatively in the world (Glăveanu, 2015).

Third, every situation or problem, especially in education, can be approached from a variety of positions and their resulting perspectives. This makes being aware of multiple perspectives—including perspectives coming from different disciplines, historical times, or theoretical models—highly important for learning and creatively transforming educational content, from the arts to mathematics.

The perspectival model we propose to conceptualise learning and creativity within a unitary framework of creative learning is based largely on sociocultural and pragmatist theory. Specifically, we are referring to the social psychology and philosophy of George Herbert Mead (1934) and to neo-Meadean scholarship (Gillespie, 2005; Martin, 2005). Their basic premise is the following: there are always multiple positions and therefore perspectives from which to understand and engage with reality. Positions are defined in social and material terms as the vantage point from which perspectives are formed.

From early childhood onwards, children are introduced to different positions within play and games (e.g., hide and seek, doctor and patient, thief and police, and so on). Importantly, episodes of play, the first cultural manifestations of both learning and creativity, allow children to "move", physically and then mainly imaginatively, between different positions. This is what Gillespie and Martin (2014) call "position exchange." In doing so, they develop different perspectives on the situation, defined as action orientations (Gillespie, 2005). Indeed, a perspective is not simply an idea or a cognitive construction; it designates the intentional, psychological orientation of the person within a specific context. For instance, taking hide and seek as an example, there are two basic positions involved: the seeker and the one who hides. This game, like all others, relies on perspective taking and orchestration. The child is successful as a seeker if he or she is capable of understanding and imaginatively adopting the perspective of someone who is hiding. How else would the child know where to look? This simple dynamic involving the exchange of positions and perspectives has profound implications for creativity and learning.

The perspectival model (for more details see Glăveanu, 2015) postulates that creative learning emerges out of two interrelated processes: (1) *learning new perspectives by re-positioning oneself in relation to the situation or problem at hand*, and (2) *creating new meanings by placing multiple perspectives in dialogue with each other*. Thus, the perspectival model proposes a close and dynamic relationship between learning and creativity in which the two support one other. We learn new perspectives by interacting with others, with the help of cultural tools (such as language and technology), and by being exposed to a variety of experiences as part of the educational process. We start being creative when these perspectives are put in relation, when we reflect on what our initial perspective reveals about the others, and when we use this insight to integrate or multiply the perspectives we are learning. In this way, the creative "moment" of the process (or, rather, its creative

dimension because creativity and learning are seen here as deeply interconnected) opens up new learning opportunities in a continuous cycle.

A key element in this whole dynamic is the possibility of de-centering or taking distance from single and conventional perspectives, and exploring alternatives and contradictions. As schools are traditionally places in which children are socialised to acquire the dominant or conventional views of their community and society, reducing the act of learning to this acquiring singular perspectives on the world would sacrifice its creative potential. Creativity emerges out of difference (Glăveanu & Gillespie, 2015) and, as such, successful forms of education try to equip children with more than one perspective on things. This helps them reflect about differences in perspective and use these differences to generate new (potentially creative) ideas. For teachers, for example, this means finding multiple ways to present a topic, helping students think about it from different perspectives, as well as inviting them to reflect on these differences and the new ideas that might emerge from considering them.

This dynamic is, in many ways, the work of imagination (Ness, 2016; Zittoun & Gillespie, 2016)—the psychological function underpinning acts of perspective taking and perspective orchestration (see also Ness & Glăveanu, in press). Imagination, alimented by our social and cultural experience of occupying various positions in the world (Vygotsky, 2004), helps us both actualise and transform perspectives acquired in the past. A direct consequence is that learning and creativity are fueled by the social and cultural experiences we accumulate and their variety. The more experiences we can draw on in a certain situation, the more material we have to learn from and with which to create. However, this is not a linear relationship. Having the resources to take various perspectives does not guarantee the person will actually engage in perspective-taking. What is required is an understanding of the value of different perspectives (Glăveanu & Beghetto, 2017) and a facilitating environment that invites the person to take and orchestrate perspectives (Ness, 2017; Ness & Riese, 2015). All these elements—mobilising personal experience, valuing differences in perspective, and facilitating orchestration—are essential for educational environments. Unfortunately, education is, as this book makes explicit, under duress in many ways. It suffers from a shortage of staff and resources and, more broadly, from a troubled socio-political climate when it comes to appreciating otherness and the knowledge of others, at a global level. Yet, if creative learning is to take place, we need to ensure that classrooms are places where multiple perspectives exist and thrive.

The perspectival model suggests a series of hypotheses about perspective-taking, learning, and creativity, some of which have been already tested empirically. For example, perspective-taking was found to foster learning (Burant & Rios, 2010; Lozano, Martin Hard, & Tversky, 2006) and to enhance creative expression (Grant & Berry, 2011; Hoever, Van Knippenberg, Van Ginkel, & Barkema, 2012). This is because, for us, perspective-taking captures both sides of the coin—creativity and learning—as referred to in this chapter.

In essence, perspective-taking refers to the act of learning or acquiring a different perspective than one's own based on dialogues with others and use of material tools.

Also, the perspective being constructed connects necessarily to existing knowledge or, continuing our terminology here, existing perspectives. The degree of the difference between our current perspectives and those being taken holds the potential for creative, new ideas to emerge as part of the process. As we know, when confronted with radical differences in perspective, we tend sometimes to ignore or outright refuse the perspective of the other. This blockage of creative learning should be tackled in education, just as it is in design and the creative industries using perspective-taking tools (e.g., the Personas method, which cultivates innovation by thinking from the perspective of users; Miaskiewicz & Kozar, 2011).

Computer mediated activities and, in particular, virtual reality platforms offer a unique venue for testing our assumptions about learning and creativity (for a similar argument, see Gillespie, Corti, Evans, & Heasman, 2017; Lindgren, 2012; Wasson, Ludvigsen, & Hoppe, 2003). This advantage is underpinned by the fact that virtual world settings afford manipulating the participant's position and his or her perceptual environment. Such manipulation is most effective when it helps reposition the person and thus foster perspective-taking. The possibility of avatars (i.e., images representing a person online) to foster creative expression (see Buisine, Guegan, Barré, Segonds, & Aoussat, 2016; Guegan, Buisine, Mantelet, Maranzana, & Segonds, 2016), for instance, has been recently documented in research. Moreover, today's virtual reality headsets and similar technologies afford a much greater immersion into the situation.

The enhanced potential to facilitate perspective-taking and position-exchange should be exploited in educational research and practice. What is particularly interesting in relation to virtual reality is the fact that the individual's potential for distantiation (i.e., taking distance so as to be able to "see" things from a new perspective in Second Life environments) is matched by immersion, especially through using recent VR headsets, which are widely accessible on the market. This mix between immersion and detachment in virtual environments creates interesting opportunities for educational psychologists, educators and learning scientists to examine and foster creativity and learning in the classroom, as we go on to explore, starting from the general use of technology in education.

## 4.4 Technological Mediation of Human Activity in Education

Following the sociocultural approach, learning is an emergent property of active involvement in social practices (Säljö, 1999, 2009). It is bound to a context and requires participation in cultural practices (Cole 1996; Lave & Wenger, 1991). The sociocultural approach to technology enhanced learning (TEL, an umbrella term used in Europe to refer to information and communication technologies [ICT] used to enhance or support learning) offers a view of learning that is situated in human social practice and mediated by technological tools. We think that a technology-enhanced-creativity (TEC) notion can be envisioned, one grounded in technology's

potential to offer learners/users access to a variety of new positions and perspectives from which to approach, conceptualise, and act on the world around them.

In an educational setting, the integration of technological tools into a pedagogical culture has a learning function. This integration can be seen as "a mediator that enables students' and teachers' collaboration and creative work within and across different curriculum subjects and cross-curricular projects" (Kumpulainen, Mikkola, & Jaatinen 2014, p. 55). While the digitalisation of society is moving at a rapid pace, schools have not kept up with integrating the technologies used by students and teachers in their everyday lives (Laurillard, Oliver, Wasson, & Hoppe, 2009).

This raises questions about if and how students find relevance in their schoolwork (Kumpulainen et al., 2014). For example, while there is an increasing view of learning as a participative activity in the learning community (Kollar & Fischer, 2009), schools and institutions have been slow to react to the emergence of this new participatory culture (Jenkins, Clinton, Purushotma, Robison, & Weigel, 2006). As the articles in the Hillman and Säljö's (2016) special issue show, learners as participants and creators "challenge simple notions of learning as a reproduction of what exists, and they simultaneously pave the way for conceptions of learning that emphasize tool-mediated collaboration, innovation and a performative understanding of what it means to know" (p. 308). This dichotomy between school life and everyday life challenges researchers to ask how these two worlds can be brought closer together (Collins & Halverson, 2009; Kumpulainen et al., 2014). The same situation can be found in vocational education and higher education.

The technological mediation of human activity in education is not new and, indeed, has taken many forms. Historically, the use of ICT in education spans from the first operational instructional program developed in 1963 at Stanford University to teach elementary mathematical logic (Suppes, 1971), through artificial intelligence applications that provide adaptive learning and feedback, to current day learning apps. These are accessed on a device (e.g., smartphone, tablet) and emerging production environments enable learners to utilize such devices in order to participate more fully in creative learning processes and immersive technologies that provide virtual worlds to be explored.

In recent years, researchers have been arguing that education has to embrace technology as a tool for intellectual expression and production. The recent emergence of production and authoring tools mediates a shift where learners are not only consumers of digital materials but also creative producers (Buckingham, 2003; Buckingham & Sefton-Green, 1994; Laurillard et al., 2009; Peppler & Kafai, 2007) who participate in technology mediated learning environments that change how they learn and know (Hillman & Säljö, 2016). Laurillard et al. (2009) argue that "the use of digital technologies to enhance intellectual expressiveness and creativity" actually help "students in their appropriation of the world with a special emphasis on their intellectual development; [thus] it is essential for the education system to incorporate new digital media as tools for intellectual expression and production" (p. 289).

The use of technology for participation in creative learning processes challenges both how we understand learning and how it can be assessed. For instance, Hillman and Säljö (2016) argue that digital technologies play a significant role in learning

and knowing: "Digitization is a change of a magnitude that makes it necessary to partially reconsider what we construe as learning, [it] exerts a strong pressure on established instructional processes, and … on how the outcomes of such processes should be evaluated" (p. 308). They add that it is important to analyse, in this context, "how young people learn to participate in technology mediated environments, and how they exploit such resources for learning that is relevant across institutional boundaries" (p. 307).

As pointed out earlier, creativity and learning are part of the demand for twenty-first century skills (Trilling & Fadel, 2009), as is collaboration. Studies of computer support for collaborative learning (CSCL; Dillenbourg, Baker, Blaye, & O'Malley, 1995; Wasson & Ludvigsen, 2003) focus on understanding productive collaboration processes in various learning contexts. In CSCL, technology mediates interactions between learners, who are co-located in front of a shared screen or distributed over physical locations, and between learners and teachers or even avatars as learning companions, and so on, and can facilitate students as participators and designers (e.g., Wasson & Vold, 2012). Reflecting on these studies from the standpoint of the perspectival model already outlined, we would consider each learner as occupying, at the same time, multiple positions in relation to others (physical and virtual). They would be accessing multiple perspectives on the problem or situation at hand and, important for creative learning, trying through collaboration to articulate and move between or among the different positions and perspectives that CSCL affords.

Wake, Guribye, and Wasson (in press) present one example of this dynamic by exploring the potential of the creative design of location-based games for history learning. This example shows the potential of using authoring tools to have students engage creatively with subject matter as a focal point of creative learning activity. A scenario that engages history and media high school students in collaborative game creation, game playing, and media product development was studied both for how a group of students coordinate their collaborative work, and how the creative work of designing a location-based history game involves a series of perspectives and design decisions. The scenario was designed in close collaboration with a history teacher (who also provided digital technology help to other teachers at the school) who chose Bergen history during the World War II (WWII) and who took into account the (then) 16 locations around the city related to themes and events during WWII. Groups (of 3–4 students) collaboratively created games for their peers and, in this way, were accountable for a useful learning experience. These student designers had to rely on their creativity in writing an engaging, coherent storyline. The authoring tool SILO was used to mediate the game design process by providing an easy-to-use interface where they identified locations and entered clues to help the game players find the location. In this way, the designers not only had to construct new experiences for their peers but had to rely on their capacity to adopt their users' perspective when creating the problem to solve.

It turned out that their teacher was very satisfied with the scenario and, in particular, the importance of the collaborative creativity that was involved in creating the game and having another group play the game. Wake et al. (in press) make a key observation: "The students in this learning scenario engage creatively with the learning

materials and the resources available to them" (p. x). The teacher reported: "the participation in the scenario made them see the history in the city in a new way, and attach new meanings and associations to places already familiar to them" (p. x). This study is important in that it shows the relevance of constructionism and how students organise their creative work and interaction in game design and how they learn through such collaboration.

Academic learning, however, is not just taking place in schools or universities. In their special issue on learning, knowing and opportunities for participation, Hillman and Säljö (2016) point out that that academic learning is no longer restricted to formal settings, but rather also takes place in alternative settings "where digital technology plays a significant role and where it co-constitutes the activities of learners in significant manners" (p. 306). Kumpulainen et al. (2014) take this argument further and show that formal learning in the twenty-first century occurs across various chronotopes (i.e., patterns of organization of and across activities in space and time) and in formal and informal settings.

Kumpulainen et al. (2014) show how twenty-first century pedagogies focused on creativity and learning potentially "resonate with learners' lives and extend their opportunities for engaging in meaningful and creative learning across time and space" (p. 70). They studied the social practices of 21 Finnish elementary schools where a total of 240 students were involved in a school communal music project, the Magic Forest Musical. Over one year, students and teachers worked collaboratively, "produc[ing]… poems, short movies, audiovisual effects, animations, stories, and a composition of the musical melody using various technological tools and devices" (pp. 57–58). The study's focus was on the technology mediated creative learning practices that were embedded in the sociocultural context of the school community. Findings illuminated the nature of created chronotypes, those "novel time and space configurations" in the students' creative learning processes. As such, the learning flowed out of the traditional educational space-time configuration bound by the definition of school setting (formal) and into their out of school lives (informal). Importantly, Kumpulainen et al.'s study both illustrates what is possible when "students' learning lives' [are] fostered by the pedagogical culture of the school" (p. 68) and challenges current schooling to "create educational ecologies for such creative collaborative practices [of] learners who are to build the future" (p. 70).

In the next section, before concluding, we take a closer look at human computer interactions. In particular, our discussion considers technologies that enable an exploration of virtual worlds and augmented reality, with a view towards how they support creativity and learning.

## 4.5 Human: Computer Interaction and Virtual Worlds

As previously noted, computers are part of the sociocultural tissue in which we live. It is worthwhile to reflect, in this context, on the ways that these technological agents interact with people and can contribute to or hinder human learning and

creativity (Burkhardt & Lubart, 2010). Based on a special issue of human-computer interaction, Lubart (2005) proposed four social roles of computers: computer as nanny, computer as pen-pal, computer as coach, and computer as colleague. We review these here with a focus on how they each potentially impact creative learning.

### *4.5.1 Computer as Nanny*

Generative thinking encompasses learning and creativity. People sometimes have difficulty engaging in novel thinking, breaking away from everyday life, routine thinking, and habits. To the extent that computer technology provides a supportive setting, which "cuddles" people and facilitates access to creative learning mindsets, the computer acts as a nanny. One aspect of support concerns keeping learners on track with their projects and their goals in mind (and perhaps nudges them to respect such things as the time schedule for a task). Computers can monitor the work process and thereby provide such levels of support. As such, learners can set personal goals and deadlines and receive automatic reminders, or they can use an application to monitor their daily schedule and detect problems (e.g., interruptions). Having no breaks can pose a problem; computers could improve users' quality of life and perhaps foster learning or creative incubation by proposing breaks.

Moreover, the nanny role encompasses the provision of an environment that affords engagement in learning and creative work. This computer work environment (or desktop), much like a cabin in the woods, a beach, or a café may offer some special conditions that put a person in the creative mindset. In a similar way, environments that foster a discovery mindset, inviting the learner to travel in a novel "knowledge escape," may facilitate learning. In terms of the perspectival model, in this kind of relationship computers propose a certain number of predetermined perspectives to users who accept (or reject) the "invitation" to follow them.

### *4.5.2 Computer as Pen-Pal*

Thinking is typically, at one point or another, communicated to social others for feedback, and ultimately idea adoption. Thus, there are naturally moments when a creator or a learner may use computer technology to communicate. The affordances offered by technology have greatly expanded through cell phones, skype, chat, e-mail, video conferencing, and social media. Thus, communication technology has enriched the possibility to connect to remote others, which may contribute positively to creative work as an enriched context or negatively as a source of social pressure.

However, the development of collaborative creative projects or learning activities in team contexts is another major trend, which benefits from communication

technology. In addition to the aforementioned technological tools, there are co-working platforms that allow distance collaboration on a shared object, such as a text under simultaneous revision by multiple authors and a virtualized sketch or object (such as an architectural model) that can be examined and modified at distance by co-creators. Such evolving computer representations have been found to facilitate the exchange of ideas between and among diverse actors in complex problems such as urban planning. Electronic mail and teleconferencing software allow collaborations across time and space. Thus, the potential for more diversified, collaborative projects involving heterogeneous teams is possible and can enhance creativity and learning. In this vein, the development of brainstorming software that allows individuals to exchange ideas electronically, yielding a common pool of ideas that itself is submitted to group discussion, illustrates well the computer as a networker or facilitator. In terms of our framework, the computer as pen-pal enables learners to share perspectives and thus, can potentially lead to creative insights.

### *4.5.3 Computer as Coach*

Given that a large number of cognitive processes (e.g., divergent thinking, metaphorical thinking, free association) are involved in learning and creative thinking, it is almost certain that an individual does not master all of them. He or she may not even be aware that certain kinds of thinking may be useful in a task. Thus, the computer as an expert system, programmed to be knowledgeable in learning strategies and creativity-relevant techniques, can help the user to go as far as possible. Computers that provide information in different ways enable learners to come up with new or breakthrough ideas, which can serve to jump-start the creative learning process. If a learner is interested in trying to use a certain cognitive process, the computer can provide tutorials and exercises for advancing relevant techniques. Opportunities for learning about new perspectives and how they come about can be fostered in such a computer-assisted creative learning environment.

### *4.5.4 Computer as Colleague*

The most ambitious vision of human–computer interaction for creativity involves a real partnership, in which humans and computers work hand in hand. The idea here draws on work in artificial intelligence in which computers can themselves contribute new ideas in a dialogue with humans. The growing field of machine learning and computational creativity indicates that computers can learn complex tasks (e.g., playing chess), generate visual art (e.g., images, multimedia), musical compositions (e.g., improvisation), stories e.g., (text generation), and scientific ideas (e.g., data mining).

We can imagine a creative team composed of a human–computer duo. As such, the user proposes an initial idea which the computer modifies in a random or heuristic way and that the human modifies in turn. This cycle continues until the user or outside judge(s) decides that the production is satisfactory. One tactic in creative thinking is to rely on random or semi-random search mechanisms to generate novel, unconventional ideas. This is especially useful when one is stuck, continuing to revisit a less suitable idea. Computers can probably better implement random searches than humans can, but human beings are needed to select the best ideas and perhaps to fine-tune these, turning them into viable creative productions. Thus, it is possible to conceive of computers as real partners in creative and learning processes intervening at different points in order to generate, evaluate, or refine ideas. With this last metaphor, computers not only enable positions and perspectives, but also propose a challenge, position, and perspective with which learners are "confronted" and need to work with, accommodate, and/or resolve.

Designing systems to foster learning and/or creativity involves specifying the nature of the computer's contribution. Following this is a determination of how systems fit with the nature of the generative thinking task and to what extent the system interacts with the user to support learning and/or creativity. In this vein, the fourth author and his team have been exploring virtual reality environments since 2013 (see Lubart et al., 2018). In these systems, multiple users represented by avatars engage in individual or collective creative thinking tasks in virtual workspaces. The studies that we have conducted have employed Second Life as a readily available platform (see www.secondlife.com).

This research undertaken by Lubart et al. (2018) primarily examined the impact of the virtual workspace on creative output. In one study, we had students engage in the search for creative ideas to solve transportation issues in a big city (Paris, France). Participants worked in one of the following conditions: (a) a real meeting room that was the normal control condition, (b) a virtual version of the meeting room, (c) a virtual enhanced room resembling an artists' studio, or (d) a virtual dark and uninviting "prison-like" storage room. Findings indicate that students assigned to the virtual artist's studio tended to produce more ideas that were original than those in the other three conditions. In addition, there was no notable difference between working in the virtual and real meeting rooms. The artist studio was not a random choice as a creativity-inductive environment. In fact, we had conducted an initial study to determine the attributes of a creative work environment for the students and then we configured a virtual space to reflect their ideas (Guegan, Nelson, & Lubart, 2017). Thus, we were using here virtual reality in *nanny* mode to provide a propitious environment that supported individuals' creative thinking by repositioning participants in contexts that enable (or inhibit) the development of new perspectives.

The effect of a virtual environment on creativity is not limited, however, to the "physical" features. We examined in another line of work the influence of avatars used to represent people in the virtual world (Buisine et al., 2016; Guegan et al., 2016). In previous research, a "proteus" effect has been observed, such that assigning people an avatar with specific characteristics leads them to play these out in their

avatars' behaviour. For example, providing a sexy avatar is associated with more socializing by the user with that avatar when in a virtual bar scene and upon leaving virtual reality and returning to "first" life (i.e., participants then socialize more in real life.)

In a study with engineering students, some participants solved creative thinking tasks using a normal avatar, whereas others had a creative-looking avatar (looking like a crazy engineer) (Guegan et al., 2016). The students who solved the problem in the creative avatar's shoes produced more ideas than those in the regular avatar's shoes. Then, in a second part of the study, there was still greater performance for those who had previously received a creative avatar compared to those previously using a regular avatar (Guegan et al., 2016; Guegan, Collange, & Lubart, in press). Once again, we can observe the facilitating effect of virtual technology, again in *nanny* mode, but this time actively influencing the generation of new perspectives by giving participants a new position (physical aspect and social role) within the situation.

Finally, we examined the use of multiple user virtual environments (MUVE) for creativity in small groups, with three avatars in a neutral virtual meeting room working on a creative problem-solving task (Lubart et al., 2018). The focus was on the interaction among participants in this small group setting. Students in the avatar work group that communicated with chat text exchanges expressed nearly the same feeling of co-presence as students in the regular meeting room, with verbal exchanges. The avatar condition allowed these learners to remain anonymous (compared to a real-life room with people talking with each other). This feature can be beneficial for creativity or learning as some people in regular meetings restrain from expressing wild ideas or unexpected questions due to such concerns social image and negative feedback. This risk is reduced, however, when participants are hidden behind anonymous avatars. Overall, this type of effect entails the role of computer as *pen-pal*. Virtual reality allows new interactive modes that are difficult to envision in regular group meetings and influences the way in which perspectives are exchanged in the situation.

The empirical research briefly reviewed here explores how technology can impact creativity. Specifically, what has been addressed is the positioning of learners in a new physical context (the first study), inviting perspective taking related to a specific social role (second study), and enabling the exchange of perspectives under conditions of anonymity (third study). Most of all, the work presented on virtual reality—the first series of empirical studies to examine systematically its potential for creativity and learning—points to some facilitative effects. Of course, technology can have mixed effects and, in some cases, it can hinder creativity and learning. One pervasive example is the tendency to use Internet search engines, such as Google and Yahoo, to find information on a topic. These are the most commonly chosen sites containing information that is widely shared, including information that is even false at times.

Thus, the typical behaviour for choosing the top "hits" in an Internet search contributes to little learning and diversity in information gathering and practically no generative thinking. Internautes may well consult the same popular website, leading

to little room for idiosyncratic knowledge, a form of collective techno-driven conformity. In terms of the perspectival model, these uses of computers mainly as *coaches* can end up reinforcing dominant perspectives without displaying enough initiatives or inviting participants to look for them. Thus, as most tools, technology can help but it can also hurt when used uncritically.

## 4.6 Concluding Thoughts

In this chapter, we adopted a sociocultural approach to creativity and learning in education. This approach is based on the idea of socio-cultural and material mediation of activity and, in this case, not only other people but also technology itself can "act" as a scaffolding device for creative learning. Of course, as we briefly mentioned, this view does not imply that all uses of technology will lead to more creativity and opportunities for learning. We are not advocating a "romantic" view of technologically-enabled education. Our belief is that all creative learning there is a technological component (even when it is as simple as pen and paper) and that modern-day technologies that offer virtual and augmented realities can have a significant impact (positive or negative) on how and what we learn and create. This impact is premised on the fact that creativity and learning are intrinsically perspectival phenomena. This means that they thrive on the possibility of the user repositioning him or herself and adopting a new perspective on the situation at hand. Technology can greatly facilitate such acts of re-positioning and learning new perspectives. At the same time, by using the same means in the same manner, learners can be "blocked" into developing and practicing only a limited number of positions or perspectives. It becomes important, in the end, to consider how technology can be used in education in ways that are more fruitful.

Taking the example of virtual reality and Second Life types of environments, it is worthwhile to reflect on the settings being constructed for learners, the roles played in them, and the relationships established. First, introducing users to more than one type of environment and role is bound to diversify their range of immediate experiences, mobilize more distant experiences from the "first", offline lives, and offer resources to build on when imagining and creating (Vygotsky, 2004). Allowing students to choose their avatars and the worlds they would want to be in can spark their curiosity and encourage them to explore. At this stage, it is important to invite learners to change avatars or environments from time to time, in order to avoid being "trapped" into what might end up being stereotypical ways of relating to their new, virtual surroundings. Then, reflection needs to go into the way participants are allowed to interact in virtual worlds. Using the chat function, as indicated, can enhance their participation because they can express their ideas at any time, without the risk of interrupting others who do the same (thus diminishing production blocking, a phenomenon well documented in real-life brainstorming situations; see Nijstad, Stroebe, & Lodewijkx, 2003).

An open question remains as to how much teachers should direct the interactions among participants or generate a common set of rules for them. When constraints are too numerous or specific, these can reduce rather than increase participation in creative work. In light of the perspectival framework proposed in this chapter, creating opportunities for perspective-taking might be a highly useful way of using these new environments. For example, learners can be asked to change avatars periodically with others to "experience" the situation they are in from a new position. Creating dyads that operate in this manner might increase mutual understanding and the feeling of agency (something argued by the proponents of Position Exchange Theory; Gillespie & Martin, 2014).

In the end, the sociocultural view on creativity, learning and technology is not meant to offer (only) practical advice but should be used by teachers as an epistemological set of guidelines for (re)thinking creativity and learning within education. The notion of interdependence between person and context, as we explained at the beginning, is fundamental here. If technology is used primarily with a focus on the individual learner and his or her experience and knowledge disconnected from others, then the framework in question might be cognitive but not sociocultural. The distinctive mark of the sociocultural is that it considers learners as creative actors (see Glăveanu, 2013) whose experience of the world is mediated by interactions with others and the use of signs and tools, including technology. This involves a deep consideration of the multiple positions in the world, both physical and virtual, that learners get to experience, and the perspectives associated with them. An accompanying concern is for how these perspectives can be diversified, exchanged, and enriched as users collaborate within learning environments that are effectively supported by technology.

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