Chapter 5
Creativity and ICT: Theoretical Approaches and Perspectives in School Education

Kleopatra Nikolopoulou

Introduction

Creativity in Education

Many years ago it was thought that creativity was a separate ability of specially gifted people, who were able to utilize this skill and be distinguished in different fields. Lately, psychologists (Craft, 2011) argue that creativity is not a special skill or ability of a few individuals, but rather it is the result of specific education and learning. Creativity can be regarded as not only a quality found in exceptional individuals but also as an essential life skill through which people can develop their potential to use their imagination, to express themselves, and to make original and valued choices in their lives.

Conceptually, "creativity" is defined as the capacity of producing a new project or an idea based on imagination (Cropley, 2001). A first attempt to define the concept was made by Guilford (1950, 1986): creativity covers the most typical capabilities of creative individuals that determine the probability for a person to express a creative behavior, which manifests itself via invention, synthesis, and planning. This behavior seems to be linked with certain personality characteristics, which have speculated whether and how this behavior will be expressed: creativity concerns all people, and it is not a rare phenomenon connected only to gifted people (the differentiation among people is quantitative and not qualitative). Getzels and Jackson (1962) define creativity as the combination of those elements which are considered original and different. They stress that creativity is one of the most valuable human capabilities, but its systematic examination is rather difficult. Lowenfeld and Brittain (1975) argue that creativity is directly related to the person that defines it. Thus,

K. Nikolopoulou (✉)
University of Athens, Athens, Greece
e-mail: klnikolop@ecd.uoa.gr

some psychologists distinguish as qualitative elements of creativity the flexibility of thinking, the originality of ideas, the ability to think differently, and the ability to solve problems. Piaget (1960) defines creativity as a process of problem-solving, problem finding, exploration, and experimentation, as a process that results in thoughtful decision making. Bruner (1962) defines creativity as an action which shows a distinct and effective surprise. Through the conceptual approach, it seems difficult to integrate creativity into one definition.

Lately, researchers (Beghetto & Kaufman, 2011) focus their attention on the creative potential/power available to each person and on the techniques that can activate this potential. They mainly focus on learning specific methods and techniques which can be used by all people in order to find many alternative and original ideas to their personal, social, and professional problems. The acquisition of knowledge and skills that promote inventiveness and people's readiness to utilize these methods in their daily lives are all considered useful. Their establishment in schools is also considered useful, in modern societies. Other researchers (see Henriksen, Mishra, & Mehta, 2015; Mishra, Henriksen, & the Deep-Play Research Group, 2013) provide a framework with three dimensions (novel, effective, and whole) for a "new" definition of creativity: creativity is seen as a process of developing something that is "new," a complex skill prevalent across domains and practices.

Regarding the importance of creativity in school education, Anastasiades (2017) highlights the collaborative creativity with the use of information and communications technologies (ICT), as one of the most important tools, which the thinking teacher has in order to respond critically to the demands of our times. His recent review reports on the characteristics of creative thinking such as the imagination, originality, and innovation, as well as on the development of divergent thinking, the development of new relationships, the pedagogical use of making an error/mistake, and the emotional climate. Important prerequisites for cultivating creativity in school education are the different ways of expression, in combination with the active participation of students in the construction of knowledge (e.g., formulating a problem is a more important process than problem-solving).

This work aims to investigate the link relationship between creativity and ICT tools (or digital tools) in school education. The structure of this chapter is as follows. Initially, it presents the theoretical views and empirical data regarding the potential of ICT tools in supporting creativity. Then, it discusses the essential role of teachers in supporting the development of creativity. Finally, it presents a small-scale study which investigated high school students' views as to whether ICT have helped or hindered their creativity. As a result of the theoretical discussion and empirical findings, the cultivation of creativity with ICT in schools can be appreciated. In this paper, the terms "ICT," "new technologies," and "digital technologies" are used synonymously. The use of the term ICT implies the broad range of information and communications technologies which can be used for different purposes by learners and teachers, in many situations.

Creativity and ICT in Education

Digital information and communications technologies (ICT) can be seen as a set of tools which can be chosen as and when they are appropriate in the creative process. Creativity can be promoted and extended with the use of new technologies where there is understanding of, and opportunities for, the variety of creative processes in which learners can engage. For example, claims are made for the expression of creativity in students and young people through the use of new technologies, from mobile phones to digital video and music (Sharp & Le Metais, 2000). Voogt and Pareja Roblin (2012) compared several (international) twenty-first-century frameworks and found that in almost all frameworks, communication, collaboration, digital literacy, problem-solving, creativity, and critical thinking were mentioned as important competencies for living and working in a digital society.

2009 was a year of creativity and innovation for Europe. The European Commission presented the results of the first survey on creativity and innovation in schools (European Commission, 2014–2015). The results showed that 94% of European teachers believe that creativity is a cornerstone skill that should be developed at school, while 88% are convinced that each of us can be creative. To make this a reality, 80% of teachers consider as important the ICT tools: computers, educational software, videos, online collaborative learning tools, virtual learning environments, interactive whiteboards, online free material, and online courses. Almost everyone believes that creativity can find a scope in every field of knowledge and school lesson, and it is not only related to those activities/lessons inherently creative such as arts, music, or theater. According to the survey, this approach is particularly important for the development of creativity as a multifaceted capacity, as it contains elements of curiosity, analysis, and imagination, together with the critical and strategic thinking.

The Potential of ICT Tools in Supporting Creativity

The use of the term ICT as a single term is inadequate to describe the range of technologies and the wide variety of settings and interventions in which they are used. McFarlane (2001) argues that there is a need for a more detailed and developed discourse to reflect the relationship between an ICT tool, the way in which it is used and any impact it may have on the users, from using word processors for writing letters to monitoring and measuring environmental changes with sensors. As there are different main factors (how students learn, the type and the use of ICT tools, the pedagogical approaches used, the design and implementation of curricula) that should be taken into account in the process of learning with ICT (Nikolopoulou, 2010), it is necessary to investigate the complexities of frameworks within which ICT tools are being used, without anticipating similar results for all students, in all cases. Indicatively, Anastasiades (2017) reports that, ICT, under appropriate

pedagogical conditions, may be one of the most important tools for teachers and students to develop cognitive, social, and technological skills.

Loveless (2002, 2007) investigated the characteristics of digital technologies that allow students to be creative: interactivity, multiple types/forms of information, range, speed, and automatic functions, characteristics that allow users to do things that could not be done as effectively, or at all, by using other tools. For example, ICT tools enable users to make changes, to try out alternatives, and to keep the traces of the development of their ideas. Interactivity engages students-users at different levels, from playing games (which provide feedback to users' decisions) to monitoring-recording the results of an experiment (which again provide immediate and dynamic feedback). Additionally, the speed and automatic functions allow the ICT operations of storage, transformation, and display of information, so that students can engage in higher cognitive levels (e.g., interpretation, analysis, and synthesis of information). The recognition of the specific characteristics of digital technologies (ICT tools) allows students and teachers to decide when and how to use them. One of the key affordances of digital technologies is that content or knowledge can be created, shared, and discovered much more quickly and easily (Henriksen, Mishra, & Fisser, 2016). New technologies have much to offer to the world of creative sharing: for example, new applications for content development/creation, sharing videos/audio/images across global contexts, and websites that allow diverse creators to share content (such as YouTube). Taking into account the relevant literature (Cropley, 2001; Loveless, 2002, 2007; Mishra et al., 2013), Table 5.1 shows, indicatively, the specific characteristics of ICT tools and the basic features of creativity (elements of creative processes). It is noted that a single ICT characteristic may correspond to two or more elements of creative processes.

According to Table 5.1, knowledge of the specific characteristics/features of ICT tools (i.e., their dynamics in the educational process) can lead to informed choices about when using such tools, as well as to the evaluation of their use. It is the

Table 5.1 Specific characteristics of ICT tools and the basic features of creativity

Characteristics of ICT tools	Basic features of creativity (elements of creative processes)
Interactivity	Inventing
Multiple types of information	Desire for novelty
	Developing new ideas
Capacity	Using imagination
Range	Finding and solving problems
Speed	Linking apparently separate fields
Automatic functions	Being original
Electronic communication	Divergent and critical thinking
Distribution of information/ materials	Autonomy and resilience
	Curiosity
	Effectiveness
	Analyzing and synthesizing skills

interaction between the distinctive features of ICT and the characteristics of creativity that opens up new perspectives for the development of creativity in education. Next section attempts to describe the interaction between features of ICT and the features of creativity, by using certain examples (on the basis of Table 5.1).

Examples of Creative Uses of ICT Tools

It is important to note that it is not the access to digital resources which delivers creativity but the opportunities such access affords for interaction, participation, and the active demonstration of imagination, production, purpose, originality, and value. Creative activities with new technologies can include developing ideas, making connections, creating and making, collaboration, communication, and evaluation (Loveless, 2002). Each of these activities draws upon an interaction between features of ICT and elements of creative processes (see Table 5.1). These activities are not always discrete or sequential, and there can be an overlap of applications. For example, the interactivity and capacity of ICT to represent information in a variety of modes underpins the potential of digital technologies to promote resources for imaginative play, exploration, trying out ideas, approaches to problem-solving, taking risks in a safe environment, and making connections between ideas. Software to support this includes simulations for modeling, spreadsheets, or control technology to sense, monitor, and measure and control sequences of events. The development of ideas and hypothesis testing can be performed by using simulation software in a history or a science lesson, where students are invited to explore "what will happen if …?" Students can use scanners, cameras, and graphics software to capture and manipulate images, create, and extract meanings in visual arts. Additionally, concept mapping software can support creative processes, such as brainstorming and representation of links among concepts. Digital technologies are changing what it means to create (Tillander, 2011). For example, students are using Google Earth as more than a map: they are shifting from a passive use of a tool to an active engagement, by constructing and designing virtual tools linking educational content.

Also, the use of ICT tools (e.g., interactive presentations) for the creation of multimodal texts with pictures, written text, animation, sound, and hyperlinks is a creative activity that enhances the imagination of students. ICT can play a role in making connections with other people, projects, information, and resources through the Internet. Knowledge is constructed through the interaction and communication with others in communities (Somekh, 2001). The speed and range of ICT tools provide opportunities for collaboration with others, directly and creatively. For example, the contribution of web2.0 is to encourage participatory culture by creating and sharing content in different social and cultural contexts (Anastasiades, 2017), while the use of group creative techniques (the groups work exclusively via the electronic environment) impact positively on production and processing of multiple alternatives, reinforcing the creativity of groups (Fesakis & Lappas, 2014). Another example is that programming environments allow students to detect and control events

and processes to create their own applications in visual programming environments. Topali and Mikropoulos (2015) showed that those elementary school students who were involved in the process of creating simple educational games (programming in Scratch) were converted from ordinary users to authors, developing algorithmic thinking and constructing knowledge.

Creative uses of ICT can take place both in a specific (physical) space and time (e.g., the use of a computer or interactive whiteboard in the classroom) and also outside the classroom, in other than the school time (e.g., the use of mobile technologies or videoconferencing). The research field of human interaction with digital technologies with the aim to develop and promote creativity is in progress (Buckingham, 2013). As well as the physical spaces in which ICT resources are made available to promote learners' creativity, ICT applications themselves can provide environments for creative activity. For example, virtual reality environments and knowledge forums are spaces for potentially creative collaboration. Storyboard software has the potential to support students' engagement with and understanding of complex texts.

The Role of Teachers in Supporting the Development of Creativity in Classrooms

The integration of digital media and technology in school education is a priority of educational policy throughout Europe. It is now proven that for a well-designed ICT integration in education, it is not only new instruments and tools that are required but deep pedagogical changes through the school system itself and a more personalized approach to learning (Bocconi, Kampylis, & Punie, 2012). Mishra, Koehler, and Henriksen (2011) have argued that the best uses of educational technology must be grounded in a creative mindset that embraces openness for the new and intellectual risk taking and that this is a challenge for teachers. The researchers suggest that teachers must be creative in devising new ways of thinking about technology, particularly for teaching specific content. Ertmer, Ottenbreit-Leftwich, Sadikb, Sendurur, and Sendurur (2012) suggest building teaching dispositions that take advantage of the affordances of new tools for learning and thinking creatively, in ways not possible without new technologies.

Thus, the important role of teachers in the learning environments of the twenty-first century is highlighted. This role is directly related to teacher training and professional development and to the methods—activities for the development of creativity in schools. The following subsections briefly discuss these issues.

Teacher Training and Professional Development

In recent years, efforts are made in order to implement/cultivate creativity in school education, by establishing new organizational models such as the interdisciplinary model of learning and contemporary methodological frameworks. However, the

new teaching materials and the modern methods are not enough, as it is required for teachers to receive appropriate training, to adopt innovations, and to introduce creative thinking in schools. As Paraskevopoulos (2004) mentioned, teacher training should aim at (a) the acquisition of knowledge about the nature, assessment, and cultivation of creative thinking, (b) practical training in specific techniques that will motivate creative thinking and will facilitate the production of creative ideas, and (c) teachers' change of attitudes, as well as the release of teachers' creative skills.

Loveless, Burton, and Turvey (2006) presented a theoretical framework for creativity and ICT, which can be used at the professional development of teachers. These researchers focused on the experiences of student teachers who designed, implemented, and evaluated creative activities as part of a school-based project. Their findings highlight the issue of designing appropriate learning experiences that promote and support creativity and ICT in the context of teacher education.

Teacher education students must have the opportunity to consider how creativity works in their own lives and practices, particularly with regard to technology and tools for teaching (Henriksen & Mishra, 2015). Recently, Henriksen, Hoelting, and the Deep-Play Research Group (2016) argued that teacher education and professional development are a step toward locating creativity within educational systems and suggested three key recommendations: (a) develop teacher education curriculum that integrates technology and creativity across the program, (b) specific courses/programs focusing on creativity and technology, and (c) identify or use a framework that connects creativity and technology to curriculum guidelines.

Teacher training is essential as it can assist teachers in acquiring relevant knowledge and skills in order, for example:

- To adopt methods that promote creativity and enable students to develop their creative thinking
- Not to provide ready solutions/answers to problems but to give students useful information which will serve as a source or tool to solve problems or generate ideas
- To use the potential and the affordances/assets of ICT tools
- To be flexible and adapt their methodological framework
- To utilize students' mistakes within the process of creative feedback and
- To be creative (themselves), by adopting creativity as an ability to create something new

Teachers' role in the process of supporting and developing creativity in classrooms is essential, and it is expected to have an impact on their students. Creative students, for example, may search for new ideas and solutions, may adopt new ideas and set high goals, as they may challenge the old and experiment with new situations.

Indicative Methods and Activities for the Development of Creativity in Schools

Teachers are those who will design the learning environments for the development of creativity in schools. Researchers report that such learning environments should provide opportunities for experimentation with materials, information, and ideas (Craft, 2000), opportunities for risk-taking in a creative environment, as well as opportunities for reflection and flexibility (Cropley, 2001). Additionally, the use of games and roles may enable students to develop their learning potential and to also develop their social skills (these are expected to help in generating ideas and solutions). Indicative methods and activities that can positively affect students' creativity in schools are proposed below:

- The creation of a "discovery" learning environment which will be open to new ideas.
- The method of brainstorming: this technique helps students to generate ideas, encourages reluctant students, and offers solutions.
- Focus on the process rather than on the solution.
- Focus on solution of problems that occur in everyday life, solutions based on the creative thinking of students.
- Dialogue and discussion: these are dynamic tools that allow students to express their views.
- Questions of open type, questions that may have many answers, as well as questions that stir students' imagination.
- Dramatization and role-playing (games).
- Construction/creation of objects by students.

ICT and creativity should be embedded in the school curriculum. Creativity is important across different disciplines; it is as important in science and mathematics as it is in the arts. In parallel, digital technology (ICT) has the potential to impact and change the creative processes. New technologies with their new affordances can stimulate and expand the way we think about creativity. A report published by the European Commission (Cachia, Ferrari, Ala-Mutka, & Punie, 2010) showed that around half of the teachers let their students use a wide range of technologies to learn (videos, cameras, educational software, etc.), while they prefer to stay in control of the technologies in the classroom. Allowing students to play with the tools can enhance students' motivation to think, understand, and learn in innovative ways. The process of integrating both technology and creativity into the curriculum is complex. However, the curricula documents should take into account the relevant issues so as to provide teachers with indicative activities for their lessons, as well as with examples of good practices.

A Small-Scale Study in a High School: Students' Views

Research Objectives

The objectives of the study were (1) to investigate students' views on whether the new technologies have helped or hindered their creativity and (2) to identify the keywords via which students describe the phrase "creativity with new technologies in school." It is noted that the small-scale study is distinct from the theoretical framework.

Sample, Questions, and Procedure

This small-scale study was conducted during 2 academic years, in an experimental high school in Piraeus, Greece, with students aged 14–15 years old. The participants of the pilot study (conducted in academic year 2015–2016) were 75 students, while at the beginning of the academic year 2016–2017, the participants were 81 students (i.e., a different sample, of 14–15-year-old students, who answered similar questions). All students have a computer at home. Regarding the first objective, students were asked to answer the question "how do you think the new technologies (ICT) have helped you, or hindered you, in being creative?" Regarding the second objective, they were asked to write down up to five words that come up to their mind when hearing the phrase "creativity with new technologies (at school)." Additionally, during the academic year 2016–2017, students were also asked to identify creative and noncreative activities. The short questions were answered anonymously and were given to their science teacher (author of this paper).

Results

Regarding the first objective, Table 5.2 shows the students' views as to whether ICT has helped or hindered their creativity. Most students answered that ICT has helped them in being creative, and more specifically they focused on information and the Internet (63 references), on school work (22 references), and on entertainment (17 references). Fewer responses were related to ICT as a barrier for their creativity (e.g., distraction, attachment to the screen) and to neutral views (ICT neither helped nor hindered me).

Some excerpts from students' responses are presented below. Regarding the contribution of ICT in being creative, they wrote:

> New technologies have not hindered me at all, in being creative. On the contrary, they gave me inspiration for my school work and daily information on various issues – they helped me enough.

Table 5.2 Students' views as to whether ICT has helped or hindered their creativity

Students' views	Number of references
ICT has helped my creativity	
Information, the Internet	63
School work/tasks, reading	22
Entertainment	17
Communication, socialization	11
New ideas	9
Mobile phones	5
ICT has prevented my creativity	
Diminishes my concentration, I stay on screen	11
I do not try	7
De-socialization	4
Neutral views (neither helped nor prevented my creativity)	9

They helped me because through technology, I have access to art sites, and painting is my hobby. Additionally, I get to know people who live far away and I talk with them, broadening my horizons.

The technology is useful to communicate with each other… the computer is useful in entertainment, songs, video, information.

With new technology I got ideas and help, so that I can answer several questions.

As seen above, most answers focused on specific assets/possibilities of information and communication, broadly provided via the Internet. This was expected since the Internet is predominantly used by adolescents in comparison with other ICT tools or applications (e.g., simulations).

Regarding students' views on ICT as a barrier to their creativity, they wrote:

Because of the technology, I think, we are *being carried away*, we waste our time

the new technologies prevent us, they do not allow us in being creative.

… ICT is an obstacle to our socialization.

They prevent young people in being creative and in expressing freely themselves… behind the screen the adolescents hide their feelings.

Finally, a neutral answer was: "New technologies have neither helped me, nor blocked me in being creative. I am not particularly in favor of computers, but this does not mean I do not follow the evolution of the technology."

Regarding the second objective, students were asked to write down up to five keywords which come up in their mind, when they hear the phrase "creativity with ICT at school." Table 5.3 shows the most frequently written keywords. Most references (68) were related to the word "computers" or "activities on the computer."

Table 5.3 Frequently used keywords, written by the students when identifying the phrase "creativity with ICT at school"

Keywords	Number of references
Computers, activities on the computer	68
Internet	35
Collaboration in groups	30
Project	28
Interactive whiteboard	24
Entertainment, games	24
Creativity	19
Experiments	18
Projector	12
Information technology, programming	14
Communication	14
E-class	11

Other frequently mentioned words were the "Internet" (35 references), "collaboration in groups" (30 references), "interactive whiteboard" (24 references), and "entertainment/games" (24 references). From Table 5.3, it seems that some keywords reported by the students are similar to words/procedures that are linked to creative uses of ICT tools (as reported in literature). For example, references were made to the Internet, collaboration in groups, and programming. It is noted that these students have school experiences in the use of ICT in class (e.g., the Internet, interactive whiteboard, e-class), within different school subjects, as well as experiences of group collaboration and participation in projects (e.g., within the school or in collaborating with other schools). The words reported were also linked to their school experiences, a fact which highlights the essential role of the school in broadening students' experiences. The investigation of students' views is a first stage which can facilitate the design of a future large-scale study.

Those students who participated in the study during the academic year 2016–2017 were also asked to identify creative and noncreative activities with ICT. Creative activities were identified as the following: finding information on the web, listening to music or watching videos, communicating with others (e.g., via the social media), and some school activities (e.g., participating in e-twinning projects or in e-class). As noncreative activities they predominantly identified the online games (played on computer or on mobile phones), while a few students mentioned the social media. It is interesting that playing online games and participating in social media have been identified both as creative and noncreative activities. As one pupil put it: "e-class and school work with ICT are useful and creative, as well as is the entertainment. Since ICT facilitates communication, de-socialization happens only when someone loses the measure (i.e., uses this for a long period of time)."

Discussion

This paper attempted to explore the link between creativity and ICT tools in school education. Theoretical approaches and empirical data reveal the potential of ICT to support creativity. The small-scale study revealed that most pupils believe ICT has helped their creativity. The reasons for this, as well as the creative activities reported by many pupils (e.g., finding information and communicating via the Internet, collaboration with others, entertainment, projects), are within the spectrum of creative uses of ICT reported in the literature (Anastasiades, 2017; Loveless, 2002). The words used by pupils to describe "creativity with new technologies in school" were linked to their school experiences, a fact which strengthens the essential role of the school in enhancing pupils' learning experiences. Researchers (e.g., Mishra et al., 2011) highlighted the essential role of teachers in supporting the development of creativity in classrooms.

Limitations of the small-scale study include (1) how do students understand the phrase "creativity" and (2) how the role of ICT is being identified via the keywords shown in Table 5.3. For a future study, it is suggested to conduct a number of interviews with pupils, so as the qualitative data to complement the quantitative data. The small-scale case study was carried out in an experimental school in Greece. The policy of this school encourages teachers to undertake research initiatives, to try new methods, and to disseminate the findings. The findings of this study may have implications for this school's teachers. It is suggested for teachers to be aware of pupils' views, so as to motivate them to carry out innovative work and to cultivate creativity with ICT in school education.

Further research is needed in order to understand how creativity can be supported and developed through ICT in contemporary classrooms. Henriksen, Hoelting, et al. (2016) argue for a greater push for research to identify models and practices: there is a need for a more systematic research regarding the use of new technologies and their reciprocal relationship with creativity in education.

Taking into account that ICT applications change over time, and that creative processes may also change, some indicative questions for future research are: (a) what is gained and what is lost in experiences, in using ICT in creative practices? and (b) how are we using specific ICT tools (e.g., a paint program) to carry out activities we have done in the past by other means? Future research is useful to investigate the connections between disciplinary areas (arts, science, music, mathematics, literature, etc.) and creative ICT practices, as well as to develop approaches to creativity in contemporary classrooms.

References

Anastasiades, P. (2017). ICT and collaborative creativity in modern school towards knowledge society. In P. Anastasiades & N. Zaranis (Eds.), *Research on e-learning and ICT in education: Technological, pedagogical and instructional perspectives* (pp. 17–29). New York: Springer. https://doi.org/10.1007/978-3-319-34127-9

Beghetto, R. A., & Kaufman, J. C. (2011). Teaching for creativity with disciplined improvisation. In R. K. Sawyer (Ed.), *Structure and improvisation in creative teaching* (pp. 94–109). New York: Cambridge University Press.

Bocconi, S., Kampylis, P., & Punie, Y. (2012). *Creative classrooms and teachers in the 21st century*. eLearning Papers, ISSN: 1887-1542, Paper 30. Retrieved November 10, 2015, from http://www.openeducationeuropa.eu/sites/default/files/old/Abstracts_EL_4.pdf

Bruner, J. (1962). *On knowing: Essays for the left hand*. Cambridge: Harvard Press.

Buckingham, D. (2013). Teaching the creative class? Media education and the media industries in the age of "participatory culture". *Journal of Media Practice, 14*, 25–41.

Cachia, R., Ferrari, A., Ala-Mutka, K., & Punie, Y. (2010). *Creative learning and innovative teaching*. Final report on the study on creativity and innovation in education in the EU member states. European Commission, Institute for Prospective Technological Studies.

Craft, A. (2000). *Creativity across the primary curriculum: Framing and developing practice*. London: Routledge.

Craft, A. (2011). *Creativity and education futures: Learning in a digital age*. Stoke-on-Trent: Trentham Books.

Cropley, A. (2001). *Creativity in education and learning*. London: Kogan Page.

Ertmer, P., Ottenbreit-Leftwich, A., Sadikb, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 2*(59), 423–435.

European Commission. (2014–2015). *ICT research and innovation for creative industries and cultural heritage*. Retrieved November 10, 2015, from http://www.openscience.gr/el/news

Fesakis, G., & Lappas, D. (2014). Reinforcement of creativity in collaborative learning activities supported by ICT. In P. Anastasiades, N. Zaranis, V. Oikonomidis, & M. Kalogiannakis (Eds.), *Proceedings of the 9th Pan-Hellenic Conference with International Participation 'ICTs in Education'* (pp. 560–567). ETPE & University of Crete, Rethymno 3–5/10/2014 (in Greek).

Getzels, J., & Jackson, P. (1962). *Creativity and intelligence: Explorations with gifted pupils*. New York: Wiley.

Guilford, J. (1950). Creativity: Its measurement and development. *American Psychologist, 5*(2), 444–454.

Guilford, J. (1986). *Creative talents: Their nature, uses and development*. New York: Bearly Limited.

Henriksen, D., Hoelting, M., & the Deep-Play Research Group. (2016). Rethinking creativity and technology in the 21st century: Creativity in a YouTube world. *TechTrends, 60*(2), 102–106.

Henriksen, D., & Mishra, P. (2015). We teach who we are: Creativity in the lives and practices of accomplished teachers. *Teachers College Record, 117*(7), 1–46.

Henriksen, D., Mishra, P., & Fisser, P. (2016). Infusing creativity and technology in 21st century education: A systemic view for change. *Educational Technology and Society, 19*(3), 27–37.

Henriksen, D., Mishra, P., & Mehta, R. (2015). Novel, effective, whole: Toward a NEW framework for evaluations of creative products. *Journal of Technology and Teacher Education, 23*(3), 455–478.

Loveless, A. (2002). *Literature review in creativity, new technologies and learning*. A NESTA. Futurelab Research report 4.

Loveless, A. (2007). *Creativity, technology and learning – A review of recent literature, No. 4 update*. Retrieved November 10, 2015, from http://archive.futurelab.org.uk/resources/documents/lit_reviews/Creativity_Review_update.pdf

Loveless, A., Burton, J., & Turvey, K. (2006). Developing conceptual frameworks for creativity, ICT and teacher education. *Thinking Skills and Creativity, 1*(1), 3–13.

Lowenfeld, V., & Brittain, W. (1975). *Creative and mental growth*. London: Macmillan.

McFarlane, A. (2001). Perspectives on the relationships between ICT and assessment. *Journal of Computer Assisted Learning, 17*(3), 227–234.

Mishra, P., Henriksen, D., & the Deep-Play Research Group. (2013). A new approach to defining and measuring creativity: Rethinking technology & creativity in the 21st century. *TechTrends, 57*(5), 10–13.

Mishra, P., Koehler, M., & Henriksen, D. (2011). The seven trans-disciplinary habits of mind: Extending the TPACK framework towards 21st century learning. *Educational Technology, 11*(2), 22–28.

Nikolopoulou, K. (2010). Methods for investigating young children's learning and development with information technology. In A. McDougall, J. Murnane, A. Jones, & N. Reynolds (Eds.), *Researching IT in education: Theory, practice and future directions* (pp. 183–191). London: Routledge.

Paraskevopoulos, J. (2004). *Creative thought in school and in family*. Athens (in Greek).

Piaget, J. (1960). *The child's concept of the word*. New Jersey: Helix Books.

Sharp, C., & Le Metais, J. (2000). *The arts, creativity and cultural education*. London: International Review of Curriculum and Assessment Frameworks.

Somekh, B. (2001). Methodological issues in identifying and describing the way knowledge is constructed with and without ICT. *Journal of Information Technology for Teacher Education, 10*(1 & 2), 157–178.

Tillander, M. (2011). Creativity, technology, art, and pedagogical practices. *Art Education, 64*, 40–46.

Topali, P., & Mikropoulos, A. (2015). Elementary school pupils learn programming by creating games in Scratch. In V. Dagdilelis, A. Ladias, K. Bikos, H. Drenoyianni, & M. Tsitouridou (Eds.) *Proceedings of the 4th Educational Conference on 'ICT Integration in Educational Process'*. ETPE, Aristotle University of Thessaloniki & University of Macedonia, Thessaloniki, 10/10–1/11 2015 (in Greek).

Voogt, J., & Pareja Roblin, N. (2012). Teaching and learning in the 21st century. A comparative analysis of international frameworks. *Journal of Curriculum Studies, 44*(3), 299–321.