INTEGRATING CREATIVITY AND INNOVATION THROUGH EDUCATIONAL TECHNOLOGY IN 21ST CENTURY TEACHER EDUCATION FOR LIFE LONG LEARNING

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ABSTRACT

In this paper, we explore creativity alongside educational technology, as fundamental constructs of 21st century education. Creativity has become increasingly important, as one of the most important and noted skills for success in the 21st century. We offer a definition of creativity; and draw upon a systems model of creativity, to suggest that creativity emerges and exists within a system, rather than only at the level of individual processes. We suggest that effective infusion of creativity and technology in teacher education must be considered in a three-fold systematic manner: at the levels of teacher education, assessment and educational policy. We provide research and practical implications with broad recommendations across these three areas, to build discourse around integrating creativity and innovation through educational technology in 21st century teacher education program for life long learning.

KEYWORD: Creativity, Technology, Teacher Education, Teacher Professional Development, Educational Technology, Policy, Innovation.

INTRODUCTION

In this article, we explore creativity alongside educational technology, for 21st century education. Creativity has been a heightened discussion in fields such as psychology and education (Sternberg, 2000; Sweller, 2009), and in popular interest, in broader culture as well. Lewis (2008) noted that creativity is a coveted quality of thinking often an important aspect of innovation and change. There has also been increasing educational research to support the importance of creativity in fields of thinking and learning (Henriksen& Mishra, 2015; Robinson, 2011; Williams, 2002).

Much of the research on creativity has focused on individual creativity, or psychological, psychometric or personality approaches. There has been comparatively little research on creativity in classrooms (De SouzaFleith, 2000). The field of education must consider the applications and rationale of creative educational practice and policy, especially for 21st century technology-rich contexts. New technologies have altered teaching and learning rapidly, with innovations and affordances for creating and sharing ideas and content. We must consider the development and impact of learning technology not in isolation, but rather alongside opportunities for creative education.

We begin by considering the global context for an emphasis on creativity, then describe the foundations for creativity in society and in education, alongside educational technology. This emphasis on creativity and its curricular integration requires forethought and planning. In drawing on a systems model for creativity in broader culture, we suggest that there are three threads of importance for creative education with technology: teacher education, assessment and educational policy. In this three-pronged approach, we describe how each has a role in building appropriate educational contexts to meet the needs of 21st century learners and teachers.

Innovation in Educational Practices
The rapid pace of new technology development has presented a challenge for classroom technology integration (Zhao, 2012). Creativity is deeply connected to issues of technology integration, so these issues of creativity and technology can be considered in tandem.While new technologies and discoveries have been a constant through human history, digital technologies rapidly scale up the technological growth. We have seen an incredible flowering of creativity and innovation fuelled by the capabilities of such technologies. From Google to Facebook, from cloud computing to YouTube channels, digitality has altered how we live, work and connect with each other (Mishra &Henriksen, 2013). Technological change is driven by human creativity, and in turn provides new contexts and tools for creative output. Given this reciprocal relationship between creativity and technology we suggest that teaching and learning must emphasize their connection (Henriksen, Hoelting, & The Deep-Play Research Group, 2016). It is important to explore the relationship between these constructs across varied, global educational contexts.

This is a challenge, because even as standalone issues, both have confounded attempts at common, effective educational approaches. Yet a better understanding is vital. Creative thinking is essential for 21st century success, associetal problems become more interdependent, global and complex. Daniel Pink (2005) has stated that the skills that were important in the past (the popularly termed "left-brain" skills) are still important but not enough. He suggests that "the 'right brain' qualities of inventiveness, empathy, joyfulness, and meaning increasingly will determine who flourishes and who flounders (Pink, 2015, p. 3)."
While there has been increased interest around creativity in education, this has not always translated into practice. Traditional "drill and kill" approaches or standards-based teaching have often squeezed creativity out of the curriculum or areas of policy and assessment (Giroux & Schmidt, 2004). For all its importance, creativity is a concept that has not been well understood, framed, or defined. Education needs a frame to help students and teachers develop creative thinking skills that span disciplines, and use technology tools for creative solutions and outcomes. In the next section, we consider some key literature on creativity, and situate our thinking in a definition of "creativity."

The Concept of Creativity
Creativity can be viewed as a process and/or a product, and is generally thought of as the production of useful solutions to problems, or novel and effective ideas (Amabile, 1996). An idea that has novelty, but lacks in value or effectiveness to other people, cannot be considered "creative" (Cropley, 2003).Two factors in most discussions of creativity are "novelty" (or newness, originality, freshness, uniqueness, etc.) and "effectiveness" (or value, usefulness, quality, etc.) (Sternberg, 2006). But while these two recur in many definitions for creativity, some scholars have called for the inclusion of a subtler, third component.

Sternberg and O'Hara (1999) argued that "task appropriateness" should be added to the definition, speaking to the contextuality in creative work. Based on this, creativity lies in the ability to create ideas or works that are "novel, high in quality, and task appropriate" (p. 255). This suggests that creative work is dependent on context, because it is assigned value in relation to the domain it is created within. Mishra, and Henriksen (2013) note that an innovative mathematical proof or a unique beautiful painting are incredible different things, yet they are both "creative." They both have an aesthetic context that goes beyond novelty and utility. Mishra and Koehler (2008) describe this aesthetic sensibility in context as "wholeness," which is a third, crucial component of creativity. Thus they offer a "NEW" (novel, effective, whole) definition of creativity (Mishra & Koehler, 2008; Mishra, &Henriksen, 2013).

Here, we suggest this NEW definition for educational contexts, and as our definition in this article. We define creativity as both the off-noted "novel," and "effective," in addition to the subtler component of "wholeness" (or context, important to education). Recent scholarship has focused on this definition of creativity, along with attempts to develop rubrics to measure creative student output (Henriksen, Mishra, & Mehta, 2015; Mishra, Henriksen & Mehta, 2015).

Educational System and Creativity

Education deals with the discovery of hidden capacities, energies and abilities of individual and development of them to the top level for the benefit of individual; himself and the society. Everybody takes by heredity special capacities, energies and abilities from his parents. Leaving the individual without education, these capacities, energies and abilities are wasted from the view point of both individual and society. Thus, the education is an investment on a long range. When educational system is doing its function it balances between the benefits of individual and society, not sacrificing the benefits of one side for the other. In each society there is a unique educational system that fulfils this balance. Educational system should always be a pioneer in directing the individuals towards the best in all areas of life. For this purpose it has to play the leading role when its function related with those dealing with the benefits of the society. There is no big crises for educational system such as being behind other sectors in the society. The development, changing improvement and forwarding of society, depend on the thinkers of that society and labor power who try to put the thoughts into application. The education and training in the area of creativity has not paid enough attention for a long time because of the complexity of the area. Without this education and training the society can not be developed, can not take its status in the world and can not solve their problems properly. The education of both of thinkers and labor sectors depends on the educational system. The educational system which just transfers cumulative knowledge and depends on imitation of others can not solve the problems in continuously changing world and will face new problems continuously. In facing these challenges just transferring the knowledge will not be enough for the educational system. Thus, an educational system that basis on creativity, encourages the creativity and works for achieving creativity. It is too necessary to educate and train the people who can develop the society towards the best, who can use their creative capabilities and take the responsibilities of competitive changing world on the national and international basis. We are living now in a knowledge explosion century in which knowledge each year is doubled. The doubling of knowledge is taking place in less time while we are advancing forward. This cumulative knowledge only can be learned just by an educational system that depends on aiming creativity and using methods of creativity. We have been experiencing a technological revolution. The basis of development and improvement is formulated by advanced

technology. Regarding information technology and investment in the area of computer earns much money for the investors. Technology is a product of creative works and is a very wide and fertilized area for creativity. Educational system has to play important role in achieving the objectives of society. The educational programs that emphasize the creativity develop the creativity of individuals. Torrance (1994; 137) points out that Japanese society starting from kindergarten encourages creativity. The whole educational program emphasizes fine arts, gives priority to historical customs and is formulated on achieving creativity in small groups by cooperation.

Educational Technology and Creativity

Ridha (1997; 384-385) and Rıza (2000; 40-41) defined educational technology as being "An amalgamation of systems derived from scientific data to be applied in broad areas of education, dealing with specific objectives, contents, instructional methods, audio visual materials, measurement and evaluation, creating a proper environment for learning, aiming at use of teachers and students' power in a proper way in order to solve the problems of education, raise the quality of learning and highlight the productivity."Educational technology as it seems from the definition is a systems amalgamation of nine elements. It is an interacted combination of these elements. On the other hand it is a way of thinking, a systematic approach dealing with all aspects of education. Its usefulness especially with creativity seems to appear when it is used in this way. Looking at educational technology as being audiovisual aids or instructional methods decreases its effectiveness due to uncontrollable factors that are neglected in each research. Technology is a product of creativity and creativity is needed in all aspects of technological revolution and the different areas of education. Because of the great scientific and technological developments generally in twentieth century and especially in the last two decades different aspects of the educational systems have to take these developments into consideration. In any research especially those dealing with creativity, all the following factors should be concerned as a whole:

a. Specific Objectives

Ignoring the objectives in research dealing effectiveness of educational technology leads to ambiguities and complexities. These ambiguities and complexities may cause concentration on low levels in the hierarchy of educational objectives. This situation probably gives chances for achieving unwanted and disliked results. Specifying the objectives is very important task that has to be given a special attention. It enables researchers to identify what has been and what has not been achieved. Specifying the objectives creates chances to know what type and which level of objectives have been identified. If diversity leads to creativity is accepted as a fact then, efforts have to be given to concentrate on all types and levels of objectives. While the low and intermediate levels of objectives should not be ignored, the consideration should be given on the highest levels for creativity purposes. Thus, computers should not be used for achieving low levels of objectives in the hierarchy. While the low and intermediate levels of objectives could be achieved by cheaper equipment and instructional methods, computers (the most expensive tools) should be used for achieving the highest levels of objectives. Using higher technology for low levels of objectives is wasting time, effort and money. Creativity could be achieved in the best way when the students participate in specifying the objectives. While this procedure is not easy and many difficulties can be faced in the beginning it should not be ignored at all in researches. The educational aims have to be formulated first. Then, they have to be transferred into objectives apparently for researchers, teachers, students and all who are concerned in the area of education. Defining the specific objectives in any research for the purpose of achieving creativity has to be given priority. Creativity can be achieved when objectives from three categories are formulated.

Regarding this area, Torrance (1994; 125) points out the importance of the practice revealed in his researches in 1964 and 1965. The students who used scientific laboratories compared with those who did not use these laboratories were in their achievements equal to others but in developing their creativity, written creativity, originality, imagination, their professional interests towards the science, invention, liking the school and not being absent much better than others.

b. Contents

Educational technology is able to offer many and different alternatives. Using different resources means richness, flexibility and leads to creativity. Beside computers and the Internet, television, radio, books, journals, magazines, newspapers, journeys, exhibitions, museum, libraries, educational technology centers can be used. Each resource has advantages and disadvantages. Computers should be used only when it is more effective than any other resources. Written materials on the other hand are important when a learning package is produced. In research dealing with creativity in the area of educational technology the students have to participate in producing learning packages individually or in groups. They have to learn how to deal with written facts and present their work ineffective ways. The scripts can be prepared in many ways. Kemp (1980; 50-51) gives three examples of treating written materials for the purposes of production. Expository, personal involvement and dramatic treatments are among these ways. In expository treatment a logical demonstration is aimed. It starts with introduction, exhibition and ends with conclusion. The material also can be demonstrated in an effective way of question and answer manner. The facts have to be demonstrated after analysis and being manipulated in personal expressions, summarizing, synthesizing and evaluation in a way that the person can claim that the work is really his work and not others. It is like kneading a dough and producing something else. In personal involvement the script is demonstrated in a story manner. The dramatic treatment includes concentrating on the negative aspects of existed subject. The students in the area of educational technology have to be trained to write their scripts. The written materials have to be divided to small units. The units should not be longer than the students control in a time. Each unit has to be started by its objectives. Visual aids have to be used as much as it is possible. Every unit has to be completed by (a) question that gets the participation of listeners and measures the specified objectives. Gagne (1977: 95) indicates that verbal chains of about seven links represent the limit of what can be learned as a single event. So the written words that should be presented from the computer, TV and slide projector screens at a time should be about seven (plus or minus two) lines of seven words.

c. Instructional Methods

Generally speaking instructional methods can be classified into teacher centered and student centered categories. Putting one method in a category depends on the percentage of participation of either teacher or students. The instructional methods that are teacher-centered can not achieve much creativity because of the passive situation of students in this type of instructional methods. Thus, student-centered methods should be emphasized in area of research dealing with creativity. In other words; instead of teaching the learning process has to be emphasized. On the other hand, some students can achieve creativity when they work individually, while others can achieve it when they work in groups. Thus, both individual and group instructional methods have to be used. Using alternative instructional methods gives the students the chance of selection depending on their preference. Creating this chance gives possibility of more successfulness and consequently, creativity could be achieved in a wide range. Learning packages are a student centered individualized and independent instructional method. Producing learning packages is a very effective way in offering the chance of

achieving creativity. The students should participate in producing learning packages in research dealing with creativity in educational technology.

d. Audiovisual Materials

The learning environments that denies audiovisuals cannot achieve the creativity. Torrance, talking on deprived environments insisted that students in these environments cannot practice what is required for creativity in sciences. Thus, generally deprivation of technology and especially advanced one creates a retardation from those who posses these technologies. When these technologies are not available participation of students, adding something and solving their problems cannot be expected. On the other hand, student centered methods require availability of enough audiovisual aids. Thus, the students can use these audiovisuals when they need and wherever they want. Audiovisual aids in research dealing with creativity in educational technology can be used by both teachers and students. Using them by teachers offers a good model that could be imitated by students. Teachers' audiovisual aids demonstrations can be the starting point for the practical aspects of education. The learning by doing aspects of education can be achieved. Education by different audiovisual aids can reveal creativity of students in different ways. The creativity can be achieved by producing instructional materials in general and learning packages in specific. Thus, the students can participate in the process of production. Audiovisual aids production fulfills creativity in a proper way. Torrance (1994; 125) in his research in 1964 – 1965 emphasized that audiovisual usage can derive the creativity of students. In spite of equality in experimental and control groups; experimental group who used science laboratory developed their creativity, expressed creatively, showed originality, imagination, interests towards technical education, invention, liking school and in attending school were better than control group. Brown (1977: 80-81) indicates that the production of audiovisuals could be achieved in three levels. All these levels can be related to creative and original work. Those interrelated levels can create a very wide range of projects in individualized learning for both teachers and students. These levels are as follows:

i. Imitative Media Production: Imitation is a starting point in any kind of production. The students have to imitate others' works. But the model has to be very good and they have to know what they are really doing. In order to continue the work which has been prepared and tested by other people the instructions should be followed efficiently. Because of following samples or instructions of other people, this type of audiovisual production is called imitative production. Imitative production includes little creativity.

ii. Adaptive Media Production: Adaptive audiovisual production needs giving new shapes or using existing audiovisual aids in a different way. There are no instructions to be followed here. Instead of that, the producer has to decide, guide himself and show initiative behavior. Adaptive media production includes about 50% of creativity.

iii. Creative Invention: Creative production does not need instructions of other people or their experiences to a large extent. It includes definition of the problem in original methods and efforts are given to solve this problem. Production of concepts and original materials represent the creativity. Thus, the research should emphasize on this type of production. Learning packages should systematically follow the stages of planning, preparation, evaluation and improvement for further use in production. Teachers who take parts in research have to show efforts of being inventors. The original work of students has to be identified, presented to others, reinforced and encouraged. Work of students has to be evaluated due to the defined standards. At last; the value of creative work of students has to be comprehended when other similar works are produced later.

e. Learning Environment

Teachers who take parts in research have to create a healthy environment for creativity. They have to prevent any cultural, learning and cognitive barriers which inhibit creativity. The programs which are imposed on students limit creativity. The creativity can't be achieved in an autocratic environment. Creating a democratic environment in which every student can express his or her thoughts freely, whatever they are, is vital in achieving creativity. Creativity can be achieved where there is fun, sense of humor, spontaneity, risk and intuition. Programs have to give chances to the students to express their ideas and have to motivate them for this purpose. The students' works should be continued in an environment where the chance for comparisons among students should be forbidden. There is no way for creating competitive environment among students. Competition among students leads to frustration and complexities. Instead, the students have to compete among themselves. Teachers who take parts in research have to suggest their students to deal with new things without any fear. Students have not to be threatened by grades in any way. This position causes the students to select what satisfies the teachers more than being creative. Teachers have to show students their creative work and be good models for them. The needs of students have to be taken into account in education. If the needs of students are not taken into account and the students are educated in an environment where imposing and compelling is continued the motivation will be low and creativity cannot be achieved. Such an environment creates negative responses in students. Being serious more than what it should be blocks the students' thoughts and prevent the creativity. The environment that limits the initiation and adventure draws barriers for student's creativity. The suitable environment for creativity is the one which is democracy based. It has to be very easy and far from any imposing and compelling. In such an environment students can express their thoughts freely and without any threatening that prevent their creativity. In this environment fun, joke aspiration are used continuously. Fun plays important role in creativity of students. Individual initiations and adventures raise the students' creativity.

f. Evaluation and Measurement
Evaluation and measurement that depends on threatening cannot achieve creativity. Because students will answer the questions as they feel that their teacher wants. They answer as they hear from their teachers or as it is mentioned in resources. A wide range of techniques in evaluation and measurement should be used in all programs of research. True falls, multiple choice, filling blanks and matching types used when low level of specified objectives is aimed. Among the questions there should be some with no one right answer. Open ended questions lead students to serious thinking. There has to be that type of questions that need thoroughly thinking. It has to be emphasized on student self evaluation and measurement. The criteria for creativity should be specified in the research dealing with creativity in the items. Thus, the item bank which includes thousands items can be developed. Discussing these items and what they educational technology. The creativity is achieved ideally where the students are given chances for production. Teachers who take parts in research have to ask their students to produce evaluation and measurement can achieve with students serve creativity very much. An important advantage of computers on other audiovisuals and instructional methods is in providing the fastest feedback to students. When the immediate feedback is provided the knowledge is kept in the mind better. This advantage of computers has to be kept in mind in all types of evaluation and measurement. The evaluation and measurement in student centered education system does not include any threatening for students. It has to be related to high levels of objectives in Bloom's taxonomy. Thus, evaluation and measurement should be applied in different types, measuring originality, has got more alternatives, open ended and that type which can discover the creativity of students. Instead of imposing evaluation and measurement on students, they have to evaluate

themselves independently. The creative students' work should be emphasized. This type of works should be reinforced by educators. The best reinforcement is the one derives internally in which the students feel happy for their works.

Three stands of influence for approaching creativity in 21st century education

Our goal in this paper is to lay out a broad plan for action. We do not provide this in micro-detail because to do so would be challenging (if not impossible), given the range of settings and variables in education. But we do wish to introduce the idea that each of these three arenas of teacher education, assessment and policy are crucial to moving these ideas forward. Specifically, teacher education focused on creativity is necessary for creativity to be infused into classrooms. Teacher training must support repurposing of technologies in the classroom and teaching approaches that creatively engage students with content. However, creative student work must also be assessed, requiring an emphasis on the assessment of creative work. Finally, none of this is possible if we do not focus on the broader policy goals of integrating technology and creativity across the policy framework of education. Thus, we argue that a focus on these three areas is the first step towards locating creativity within educational systems.

Teacher education

A teacher's pedagogy is often a primary driver of how students develop and learn. Teachers who model creativity tend to fluidly enhance, support and develop the tendency in their own students (Amabile, Conti, Coon, Lazenby, &Herron, 1996). We must build teaching dispositions that take advantage of the affordances of new tools for learning and thinking creatively, in ways not possible without new technologies (Ertmer et al., 2012). But effective teaching is difficult in itself, even without the added elements of creative and technology-savvy practices. How do we support the development of creative pedagogy, along with effective use of classroom technology, to support the 21st century teacher and student? Teacher education programs are often the core driver of how new teachers see the profession, how they interact with students and develop their classroom practices and repertoire. Therefore, it becomes important that we see teacher education as a key site in developing a creative mindset and practices that encourage the use of new technologies creatively in the classroom. Yet the role of creativity and technology in teacher education is rarely clear, varying at the school/program level. It is essential to build a platform for teacher education programs that addresses creative, technology-rich approaches and pedagogies. In brief, the research and scholarship in this area suggests the following key recommendations.

Develop Teacher Education curriculum that integrates technology and creativity across the program

Current teacher education curricula may give some emphasis to teaching creatively with technology. The other aspect of teaching to enhance creativity in students, and to explore the affordances of technology to do so, has received even less attention. Integration of ideas related to creativity and technology need to be across the program and curriculum. Research has shown that highly creative teachers tend to engage in a variety of creative pursuits that they draw into their teaching practice (Henriksen& Mishra, 2015). Teacher education students could be encouraged to actively spend time in creative interests, and incorporate these into lessons and activities through technology. This might include course work that specifically asks new teachers to "play" with approaches to using technology in the curriculum in creative lessons on content. Opportunities to engage in lesson planning focused on real-world, cross-curricular and novel approaches to content and technology (TPACK) would help build creative teaching skills, as a part of a teacher education curriculum. Examples of such practices can be found in the special issue devoted to teacher education, creativity and technology (Henriksen& Mishra, 2015), and in Koehler et al. (2011).

Specific course / programs focusing on creativity and technology

Even as we seek to suffuse a "creativity mindset" across programs, we see the need for specific courses that target creativity and technology and their use in the classroom teaching/learning context. This includes more theoretical knowledge of creativity into teacher education curricula for pre-service teachers, particularly in emphasizing the relationship between creativity and student achievement or teacher effectiveness and impact(DeSouzaFleith, 2000; Henriksen& Mishra, 2015). Other researchers have highlighted the ways that TPACKcan be used as the basis of creative approaches to technology integration (Koehler et al., 2011). A theoretical understanding of creativity is something that should connect to practical applications. Teacher education students must have the opportunity to consider how creativity works in their own lives and practices, particular with regard to technology and tools for teaching. See Henriksen and Mishra (2015), and Koehler et al. (2011) for examples.

Identify / use a framework that connects creativity and technology to curriculum guidelines

Curriculum guidelines are overarching structures that determine how specific curricula are designed. It is important that the dual-goals of teaching creatively with technology, and teaching for enhancing creativity with technology, be incorporated in these guidelines. The use of theoretical frameworks (such as the systems model of creativity or TPACK) give cohesion to any research study or paradigm. Without a good framework guiding the work, it is hard to move beyond ad-hoc ideas and examples. While frameworks currently exist for creative education, or for technology infusion in education, it is difficult to find a framework that integrates the constructs. Developing such a framework would guide teacher education programs on a path that blends these ideas into their curricula.

Educational policy

'Creativity can be learned, but since it is a thinking skill it can only be "learned by doing" or as "learning in action."Creativity involves approaches to thinking rather than a set body of knowledge that can be taught. However, we can reinforce and support sustained creativity as a "habit of the mind." However, this also means that the education system and educators must recognize and support a sustained facilitation of creativity as a habit of the mind, and agree upon what that is and how to engage it. This can vary greatly across contexts and cultures. So essential challenges involve convincing policy makers, who often prefer clear answers and objectivity that it is important to infuse curricula with creativity, an area that does not have one "right" answer. Along these lines, policy must also begin to consider the intersection of technology with creativity, and offer guidelines for how these ideas can intersect in the class room. We must realize that policy texts at all levels in education (macro, meso, and micro) are predominantly indicative of practice, rather than definitive, because policies are mediated by schools, teachers and other actors in education(Ball, 1997; Wyse & Ferrari, 2014). But as we acknowledge this, policy texts are also representations of discussions on certain topics. They are important enough to be emphasized in a document, and often the basis for further curriculum development. Along with curriculum development, policy documents are often used to compare countries, regions and schools with each other. For instance, Heilmann and Korte (2010) carried out a content analysis of national curriculum texts to study the role of creativity and innovation in compulsory education in 27countries of the European Union. The outcomes of such studies can promote new policy texts and approaches. Wyseand Ferrari (2014) state: "The inclusion of explicit reference to creativity [in all national curricula of the EU27] is an indication that creativity is valued by policy-makers and curriculum developers" and "It is likely that creativity will have a more significant impact on pupils' learning if the choices made to include creativity in national curricula are coherent throughout different types and sections of texts" (p 13).

An additional challenge involves how to implement something as context-driven as creativity, and as ever-changing as technology, in ways broad enough to speak to curriculum across varied settings. The variation in language and conceptualizations of creativity, the integration of creativity across disciplines, the relation between technology and creativity, and the professional development of teachers are just a few examples of complexities to consider.

Creativity and technology need to be featured in policy at all levels (macro / meso / micro)

It is clear that creativity is complex and works across all aspects of the teaching learning process, particularly when coupled with the potentials of technology. Thus it is important that educational policy emphasize creativity across all levels: macro, meso and micro, (i.e., at the level of national policy, state or school district-wide, or individual schools and classrooms). The policy texts should in turn be incorporated into other aspects of curriculum and documentation that teachers and other stakeholders use. Policy should extend beyond the document it is built into, so that it can be operationalized and instantiated throughout the education system –particularly in documents read by teachers.

Creativity and technology should be embedded across the curriculum

Creativity is not a domain by itself but a way of thinking and approach to problem solving that cuts across disciplines. Thus creativity is as important in the sciences and mathematics as it is in the arts. Technology in turn has dramatically changed the work and creative process of almost every domain of human activity. This is often forgotten and needs to be part of every policy-makers thinking. Creativity is also not a skill that is limited to few individuals. Similarly, technology is not something that is limited to a few individuals or in a few select domains. In policy and curricular documents these issues related to creativity and technology should be part for all learners, not just for the "special" or "talented" ones.

A greater push for research to identify models and practices

Though creativity research has received greater attention recently, there is much we still do not know about its formal and informal learning contexts. The addition of technology also complicates the picture. Clearly there are models and practices that work, but more systematic research is the pressing need, both in theory and practice. The use of new technologies and their reciprocal relationship with creativity needs to be studied. We need to learn more about creativity and technology and how both can be integrated in education at all levels.

Conclusions

We began by reiterating the reasons for why creativity has been receiving increased attention in education. We offer a definition of creativity as being a process of developing something that is novel, effective and whole (NEW), and suggest that it is a complex skill prevalent across domains and practices. Moreover, we argue that a productive way of thinking about creativity not only considers *what* it is but also *where* it is located. In this a systems view of creativity captures the complexities of identifying creativity. The advent of new technologies can initiate, stimulate, broaden and expand how we think about creativity systemically. New digital and networking technologies with their dual affordances of ease of creation and ease of sharing complicates the standard systems model. In a reciprocal way, technologies support creativity even as creative approaches create new ways to use (repurpose) technologies for pedagogical purposes.

Despite the increasing importance of creativity and ICT in education, neither area has had broad-based, significant impact on teaching and learning. Part of the reason for this is in the complexity of the process of integrating both into the curriculum. The inclusion of creativity

is hampered by the fact that educators have to focus on both teaching creatively and teaching for creativity. Both of which need teacher training, new approaches to creative assessment, and broader policy frameworks that support the integration of creativity in the curriculum.

Recommendations

Based on the findings of the study we have provided broad recommendations. These recommendations are aimed across education: teachers, scholars, curriculum designers, policy makers, and researchers. It is only when all of these different stakeholders work together, for the broader goal of integrating creativity and technology in education in a system-wide manner, that we can have hope for making a change. In this way, research, practice, and policy come together. Such an alignment is necessary, if we truly believe that creativity is important for the future of education.

REFERENCES

Amabile, T. M. (1996). *Creativity in context.* Boulder, CO: Westview Press Harper Collins Publishers.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal, 39*(5), 1154-1184.

Ball, S. (1997). Policy sociology and critical social research: A Personal review of recent education policy and policy research. *British Educational Research Journal, 23*(3), 257–274.

Blicblau, A. S., & Steiner, J. M. (1998). Fostering creativity through engineering projects. *European Journal of Engineering Education, 23*(1), 55-65.

Borko, H., & Putnam, R. T. (1995). Expanding a teacher's knowledge base: A Cognitive psychological perspective on professional development. *Professional development in education: New paradigms and practices*, 35-65.

Cropley, A. J. (2003). *Creativity in education & learning.* Cornwall, UK: Routledge Falmer.

Csikszentmihalyi, M., &Csikszentmihalyi, I. S. (1988). *Optimal experiences: Psychological studies of flow in consciousness*. Cambridge, UK: Cambridge University Press.

Csikszentmihalyi, M. (1997). *Creativity: Flow and the psychology of discovery and invention.* New York, NY: Harper Collins.

DeSouzaFleith, D. (2000). Teacher and student perceptions of creativity in the classroom environment. *Roeper Review, 22*(3), 148-153.

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

Giroux, H. A., & Schmidt, M. (2004). Closing the achievement gap: A Metaphor for children left behind. *Journal of Educational Change*, *5*, 213-228.

Heilmann, G., &Korte, W. B. (2010). *The Role of creativity and innovation in school curricula in the EU27: A Content analysis of curricula documents.* Seville, Spain: European Commission, Joint Research Centre, Institute for Prospective Technological Studies.

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., & 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.

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

Koehler, M. J., Mishra, P., Bouck, E. C., DeSchryver, M., Kereluik, K., Shin, T. S., & Wolf, L. G. (2011). Deep-play: DevelopingTPACK for 21st century teachers. *International Journal of Learning Technology, 6*(2), 146-163.

Kiely, M. C. (1998). "A Piece of good news": Teaching as a creative process. *Canadian Psychology-PsychologieCanadienne, 40,*30-38.

Kim, C., Kim, M. K., Lee, C., Spector, M. J., &DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching andTeacher Education, 29*, 76–85.

Lewis, T. (2008). Creativity in technology education: Providing children with glimpses of their creative potential. *InternationalJournal of Technology and Design Education.* Doi: 10.1007/s10798-008-9051-y

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A Framework for teacher knowledge.*Teachers College Record, 108*(6), 1017-1054.

Mishra, P., & Koehler, M. J. (2008, March). *Introducing technological pedagogical content knowledge*. Paper presented at theAnnual meeting of the American Educational Research Association, New York City.

Mishra, P., Koehler, M. J., &Henriksen, D. A. (2011). The Seven trans-disciplinary habits of mind: Extending the TPACK framework towards 21st century learning. *Educational Technology, 51*(2), 22-28.

Mishra, P., &Henriksen, D. (2013). A New approach to defining and measuring creativity: Rethinking technology & creativity inthe 21st Century. *Tech Trends*, *57*(5), 10.

Mishra, P., Henriksen, D., & Mehta, R. (2015). Creativity, digitality, and teacher professional development: Unifying theory, research, and practice. In M. Niess, & H. Gillow-Wiles (Eds.) *Handbook of Research on Teacher Education in the DigitalAge*(pp. 691-722). Hershey, PA: Information Science Reference.

Pink, D. H. (2005). *A Whole new mind*. New York, NY: Riverhead Books.

Richardson, V. (1996). The Role of attitudes and beliefs in learning to teach. In J. Sikula (Ed.), *The handbook of research in teacher education* (2nd ed., pp. 102-119). New York, NY: Macmillan.

Robinson, K. (2011). *Out of our minds: Learning to be creative*. Oxford, UK: Capstone

Sternberg, R. J. (Ed.). (1999). *Handbook of creativity*. New York, NY: Cambridge University Press.

Sternberg, R. J. (2000). An Evolutionary interpretation of intelligence, creativity, and wisdom: A Link between the evolution of organisms and the evolution of ideas. *Behavioural and Brain Sciences, 23*(1), 160-161

Sternberg, R. (2006). The Nature of creativity. *Creativity Research Journal, 18*(1), 87-98.

Sternberg, R. J., & O'Hara, L. A. (1999). 13 Creativity and intelligence. In *Handbook of creativity* (pp. 251-272). Cambridge, UK: Cambridge University Press.

Sweller, J. (2009). Cognitive bases of human creativity. *Educational Psychology Review, 21*(1), 11-19.

Wyse, D., & Ferrari, A. (2015). Creativity and education: Comparing the national curricula of the states of the European Union and the United Kingdom. *British Educational Research Journal, 41*(1), 30-47.

Williams, S. D. (2002). Self-esteem and the self-censorship of creative ideas. *Personnel Review, 31*(4), 495-503.

Zhao, Y. (2012). *World class learners: Educating creative and entrepreneurial students*. Thousand Oaks, CA: Corwin Press.