

MAKER SPACE & DESIGN THINKING: EMERGING TECHNOLOGIES FOR ACHIEVING CREATIVITY AND INNOVATION IN SCHOOLS

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Abstract

Creativity and innovation are being increasingly important for the development of 21st century knowledge society. The European Commission (EC-2008c) links creativity and innovation to knowledge and sees them as essential skills to be developed in the context of life-long learning. It is no denying fact that education plays a crucial role in fostering creative and innovative skills.

In the past few years, the emergence of a new wave of technologies has been observed. The rapid development and take up of technology, especially among young people has a significant impact on education, challenging educators and institutions to address the changed learning patterns and needs of the students. Hence, we see that a number of new concept and trends have emerged in the recent past, to name a few are Brain-Based learning, Inquiry-Based learning, differentiated instruction, Flipped Classrooms, Game-Based learning, Maker Education, STEM, Design Thinking (DT), Coding in the classrooms, etc.,

This paper provides an overview of the theoretical foundations for creativity and innovation in the context of education. It also provides the conceptual framework of two emerging technologies, namely, maker space and design thinking. It also aims to explain how these technologies play a key role in fostering a creature learning and innovative teaching environment in schools and are currently offering a variety of opportunities for constructive change.

This paper attempts to answer the following questions:

1. How can we define creativity and innovation?
2. What do we understand by educational maker space?
3. What is design thinking?
4. What is the philosophy behind maker movement?
5. What are the principles underlying design thinking?
6. What are the influences of maker space and design thinking and their potential impact on education?

A brief summary of the paper is as follows:

- In this paper, creativity and innovation are understood as inter-related concepts, the first refers to a product or process, which shows a balance of originality and value and the second to the implementation of

such a product or process in a given sphere.

There are many different ways to define maker space:

- i. "A maker space is a place where students can gather to create, invent, tinker, explore and discover, using a variety, of tools and materials" (Diana Rendina, Defining Maker-spaces: what the Research say).
 - ii. "Maker space provides hands on creative ways to encourage students to design, experiment, build and invent as they deeply engage in science, engineering and tinkering". (Jennifer Cooper, Designing school maker space, Edutopia).
 - iii. Maker spaces are build on a constructive ideology as introduced by Jean Piaget and developed by Seymore Papert. The primary goal of both Constructivism and Constructionism is to have learners create their own knowledge by creating and interacting with physical objects.
- "Design thinking refers to design specific cognitive activities that designers apply during the process. Design thinking is a methodology, not exclusive for designers that help people understand and develop creative ways to solve specific issues, generally, business oriented" (Wikipedia).

Design process is what puts DT into action. It is a structured approach to generating and developing ideas. Creativity is central to the design process. The DT cycle involves observation to discover unmet needs within the context and constraints of a particular situation, framing the opportunities and scope of innovation, generating creative ideas, testing and refining solutions.

The implications and benefits of both these technologies are many and varied. Both can empower students by helping them to shift from being passive consumers of information and products to active creators and innovators.

Keywords: Creativity, Innovation, Constructivism, Knowledge, Maker space, Design Thinking.

1. INTRODUCTION

We live in a world that is changing faster than ever before and facing challenges that are unprecedented. These sorts of challenges require innovative ideas and innovation. Education has seen more innovation in its methods, practices, tools and philosophies in the past 10 to 15 years than in the 100 years. Naturally we have leaped along in technological bounds and due to the availability of various gadgets like laptops, tablet, mobile etc, the present classrooms have become more efficient and exciting.

There is a great deal of buzz in the world of education right now about creativity and innovation and why these skills should be incorporated more in the school curricula.

Franklin Melano Roosevelt once said, "We cannot always built the future for our youths, but we can build our youths for the future". This holds good in the present scenario.

In future the students who are doing work presently in the classrooms will be entering a job force that none of us can visualize. Learning a specific skill set does not have the value in today's world that it once had. Hence, learning how to be creative and thus adaptable is utmost important in present scenario to prepare students for life beyond classrooms. Schools and businesses throughout the world are focusing on to this idea and attempts are being made to provide means and ways to promote creativity. This is important to note that technology literacy is almost as important to succeeding in the world today as creativity. Both the technology and creativity go hand in hand.

2. CONCEPTUAL FRAMEWORK OF CREATIVITY & INNOVATION

Discussion about Creativity and Innovation are often made difficult because people are unclear about the exact meaning of these key terms. In particular, there is confusion about the difference between Creativity, Innovation and Invention.

Creativity: It is the capability or act of concerning something original or unusual.

Innovation: It is the implementation of something new.

Invention: It is the creation of something that has never been made before and is recognized as the product of some unique insight.

Hundreds of definitions are given for the concepts of creativity and Innovation. A few of them are given here:

- Creativity is the characteristics of a person to generate new ideas, alternative solutions and possibilities in a unique and different way.
- Creativity is the ability to conceive something unpredictable, original and unique. It must be expressive, exciting and imaginative. It is an act of unveiling something.
- Guilford (1950) defines in these words:

“In its narrower sense, creativity refers to the abilities that are more characteristic of creative people. Creative abilities determine whether the individual has the power to exhibit creative behavior to a noteworthy degree. Whether or not the individual who has the requisite abilities will actually produce results of a creative nature will depend upon his motivational and temperamental traits” (P-444).

- Cognitive Psychologist Mark Runco is a leading creativity researcher whose empirical work focuses on idea generation and divergent thinking. In his article, “the Standard Definition of Creativity”, he asserts that creativity requires both originality and effectiveness. Originality is vital for creativity but not sufficient. Ideas and products that are merely original might very well be useless. So originality is not alone sufficient for creativity. Original things must be effective to be creative. Effectiveness can take many forms like usefulness, fit or appropriateness. It can take the form of value.

- The first clear use of standard definition seems to have been in article on “Creative and Culture” written by Stein (1953). In the words of Stein, “The creative work is a novel work that is accepted as tenable or useful or satisfying by a group in some point in time --- By “novel”, I mean that the creative product did not exist previously in precisely the same form ----- the extent to which a work is novel depends on the extent to which it deviates from the traditional or the status quo ----- In speaking of creativity, therefore it is necessary to distinguish between internal and external frames of reference...” (PP-311-312).

Stein was the first to offer the standard definition in an entirely unambiguous fashion. Stein is also quoted for his other ideas on creativity like “a creative insight arises from a reintegration of already existing materials or knowledge but when it is completed it contains elements that are new” (P-311).

The European Commission (EC-2008 C) links creativity and innovation to knowledge and sees them as essential skills to be developed in the context of lifelong learning.

- Innovation is an act of implementation of new ideas. It could be the introduction of new technology or new product, or a new method of production or an improvement in the existing product. It is closely linked to creativity i.e. putting creative ideas into action is an innovation.
- The quality of thinking new ideas and putting them into reality is creativity. The act of executing the creative ideas into practice is innovation.
- Creativity is an imaginative process as opposed to innovation which is a productive process.
- Creativity is related to generation of ideas which are new and unique. Conversely, innovation is related to introduce something better into the market.
- Creativity is the ideation of a thought while innovation is the realization of the idea.

3. MAKER SPACE AND DESIGN THINKING

a) What is a Maker Space?

Maker Spaces sometimes referred to as hacker-spaces, hack spaces and fablabs are creative DIY (Do it yourself) spaces where people can get-together to invent, and learn. A maker space is a collaborative workplace inside a school library or separate public/private facility for making, learning, exploring and sharing that uses high tech to no tech tools. These spaces are open to kids, adults and entrepreneurs and have a variety of maker equipment including 3D printers, laser cutters, soldering irons and even sewing machines. A maker space however does not need to include all of these machines or even any of them to be considered a maker space. If you have cardboard, legos and art supplies you are in business. It's more of maker mind set of creating something out of nothing and exploring your own interest that is at the core of a maker space. These spaces are also helping to prepare those who need the 21st century skills in the field of science, technology, engineering and math (STEM). They provide hands on learning, help with critical thinking skills and even boost self-confidence. A maker space can take many forms.

The following definitions can help in understanding its nature.

Laura Fleming: "A maker space is a metaphor for a unique learning environment that encourages tinkering play and open-ended exploration for all".

Diana Rendina: "A maker space is a place where students can gather to create, invent, tinker, explore and discover using variety of tools and materials".

Colleen Groves: "A maker space is not only a place where you can make stuff but many times it's a place where you make "meaning" which many times is more important than the stuff you make".

I 3 Detroit.Com: "A maker space is "a collision of art, technology, learning and collaboration".

Educause.edu: "Maker spaces are zones for self-directed learning. Their hands-on character, coupled with tools and raw materials that support invention, provide the ultimate workshop for individuals who learn best by doing – they promote multi disciplinary thinking and learning, enriching the projects that are built there and the value of the maker space as an educational venue".

b) Philosophy behind maker space

Learning in a maker space is not new. It goes back to the idea of John Dewey who rejected the regimental schooling that arose during the industrial revolutions. The iterative design process that is used in maker spaces can be found in John Dewey's writing. Hence, the concept and principles of maker space are deeply rooted to the educational theory of Constructivism which is the philosophy of hands-on learning through building things. Constructivism, in turn is the application of constructivist learning principles to a hands-on learning environment. Hence Maker Education is a branch of constructivist philosophy that views learning as a highly personalized endeavor requiring the student, rather than the teacher, to initiate the learning process. So this philosophy of learning, teaches art as a guide for inquiry-based approaches to the development of knowledge and thinking process.

c) Benefits of Maker Space

In maker space, the learning happens through making, tinkering, art and engineering real things based on an individual's interest. Students are interested in this type of learning when they have an idea of to create something new (making). Tinkering is a playful way to approach and solve problems through experimentation and discovery. Engineering builds a bridge between the intuition of making and the formal aspects of science by being able to explain measure and predict the world around us. Art allows students projects to become something aesthetically pleasing. The practical skills that are developed through this process builds creative confidence in a student. In the book 'Creative Confidence' by Tom and David Kelley, the authors state that creative confidence is a way of "experiencing the world that generates new approaches and solutions". The maker mind set is a growth mindset, one that encourages students to believe they can learn to do anything. The makers movement in education helps to develop in students the full capacity, creativity and confidence to become "agents of change in their personal lives and in their community".

It also encourages children's active participation in classrooms and fosters the need to explore, create and innovate all valuable skills for learning as well as for society. It is also broad and flexible enough to be adapted to specific curriculum demands when students are more active, it shifts to teacher's role to facilitation and tutoring, and opens up space for co-creation and learning by teaching.

d) What is Design Thinking

Design thinking is a powerful way for today's students to learn, and its being implemented by educators all around the world.

- Design thinking refers to design specific cognitive activities that designers apply during the process of designing, (Wikipedia).
- Design thinking is a "formal method for practical, creative resolution of problems of issues, with the intent of an improved future. It is a methodology for actualizing our concepts and ideas", (Renven Cohen).
- Design thinking is a method of creative action, (Rolf Faste-1980).
- Design thinking is a set of tools, methods, and processes developed to get answers for challenges, big and small. Through applying design thinking to challenges, we have to define problems, understand needs and construct brainstorm innovative solutions, and seek and incorporate feedback about our ideas in or to continually make them better. The more we apply design thinking to the challenges we see, the deeper we

strengthen the belief in our ability to generate creative ideas and make positive change happen in the world. (Sandy Speicher).

- A method of meeting perfect needs and desires in a technologically feasible and strategically viable way. (Tein Brown-2008).
- In order to employ, design thinking, it is as a system of overlapping spaces, rather than a set of process steps to move through- those spaces are “inspiration” during which the problem that motivates, solution finding is identified; “ideation” the process of generating and developing idea and “implementation” the activities that enable a creative idea to move from the drawing board to the market place.
- Design thinking provides a consistent approach to defining challenges. It helps organizations identify problems before them even being the brain storming session most associated with creativity.
- The concept of DT, like creativity is continually evolving. One example of a design thinking process could have several stages; Empathize, Define, Ideate, Prototype and Test. Within these steps, problems can be framed, the right answers can be asked, more ideas can be created, and the best answers can be chosen. The steps are not linear; they can occur simultaneously, and can be repeated.

e) The need for design thinking

We are living in an age of increased complexity, and are facing global challenges at an unprecedented scale. The nature of connectivity, interactivity and information is changing at lightening speed. We need to enable a generation of leaders who believe they can make a difference in the world around them, because we need this generation to build new systems and rebuild declining ones. We need them to be great collaborators, great communicators, and great innovators.

As we help today’s students build their foundation of core academic knowledge and skills, we also need to look at the ways we are helping our youth build them confidence in their abilities to create.

f) Design thinking for Educators

Educators across the globe have been using design thinking to solve challenges in their work. Project range in scope and scale including design solution - from curriculum to space, to process and to systems.

A few implications of DT in education are:

- (i) Teacher-designed: Teachers can talk directly with the students to figure out the best design for them teaching-learning environment. Based on student’s input, he can redesign the classroom to address the needs and desires of the students.
- (ii) School-designed: The faculty of Dr Mandle Seeondary in California designed an approach called “Investigative Learning” which addresses students not as receivers of information but as shapers of knowledge. In the same way, the school can use design to address the evolving needs their students.
- (iii) Community-designed: The schools with collaboration and cooperation of learners, teachers, and families can be engaged to imagine new solutions that could help the schools be more effective.

4. CONCLUSION

In this paper, we reviewed the literature related to the conceptual framework of creativity, innovation, maker spaces and design thinking. It has also presented relevant research that has provided the basis for understanding (a) the nature of creativity and innovation and their difference, (b) the nature of maker space and design thinking.

There is considerable empirical work to be done to establish a full understanding of maker movement and design thinking. The studies surveyed in this paper show the characteristics of maker spaces and design process.

Briefly we can conclude that helping students to think creatively like makers and designers may better prepare them to deal with difficult situations and to solve complex problems in schools, in their careers, and in life in general. Current educational practices typically adhere to outdated theories of learning and pedagogy. Schools continue to focus on increasing student’s proficiency in traditional subjects such as Maths and reading, via dialectic approaches, which leaves many students disengaged. We can and should move beyond that limited forms and consider new educationally valuable skills (e.g.) making, creating, critical thinking, design thinking, multi-tasking, digital literacy etc. which in turn will help them for a better tomorrow.

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