Fostering Creativity Through Makerspace: A Review from The Industrial Design Perspective

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ABSTRACT: Makerspace is a learning environment that is based on the maker movement. It came into being around 2006 when the first maker-fair was held in United States for celebrating arts, crafts, engineering, science projects and the Do-It-Yourself (D.I.Y.) culture. The role of makerspaces in fostering creativity among students in a school setting, tertiary education and public spaces have been studied rigorously, and there is a growing interest among educators to implement this learning environment to prepare undergraduates with skills required in the 21st century. In industrial design, creativity is the primary force leading to the success of innovative products and human development. The objective of this paper is to give some insights into how maker space with its sustainability can foster industrial design students' creativity by applying design thinking methodology and project-based learning as part of the equation. Four aspects (knowledge, thinking styles, motivation and environment) adapted from the confluence theory of creativity together with the makerspace as environmental settings and the factors contributing to each element will be discussed in details.

Keywords: *Makerspace; Creativity; Industrial Design*

1. INTRODUCTION

Advancement in technology and the affordability of digital fabrication, physical computing using low-cost microprocessors has helped boost this movement in term of tools and technology. In addition to that, the of sharing of tools and ideas online as a result of globalization has also contributed to the increase of interest in this movement [1]. Makerspaces which are heavily influenced by the earlier movement of D.I.Y. (do it yourself culture) bring together people, resources, skills and tools in a physical space with the objective of learning, designing, prototyping are heavily influenced by the earlier movement of D.I.Y. (do it yourself culture) This new kind of learning environment helps boost the innovation and invention, as some might call it "the democratization of invention"[2] [3].

2. CREATIVITY

Based on the confluence theory of creativity proposed by psychologists named Sternberg and Tubart [4][5]. The theory proposes eight dimensions of the factors contributing to creativity. Sternberg and Tubart claim that intellectual skills, knowledge, motivation, the way of thinking and environment to be the main factors contributing to creativity These factors should be co-exist in order to foster creativity. The theory also suggest that there must be minimum of 3 factor coexist simultaniously. This paper proposes that there are three main factors which contribute to creativity namely knowledge, motivation and the way of thinking with environmental factor (makerspace) as a catalyst to the creativity.

3. MAKERSPACE

Makerspace environment is where self-directed learning and hands-on activities with the help of different tools and materials come together to support creativity, innovation and invention. It promotes interdisciplinary thinking and learning. Business leaders nowadays demand for graduates who are equipped with skills that require creativity and innovation which the current education system fails to produce [6]. Makerspaces are heavily influenced by constructionism methodology. In contrast, the other models of traditional teaching and learning treat the teacher as a repository and transmitter of knowledge. While some of the research in makerspace focuses on the entrepreneurship and its potential [8], Many researchers are now focusing on bringing the essence of the makerspace into the teaching and learning environment. A recent study by [9] shows that using CAD software (Solidworks) with the combination of 3d printer and makerspace environment increased the performance of the students through finding and learning a creative way of solving the problem through tinkering, experimentation and hands-on project. According to [6], there has been an increase in student-centeredness, relevancy, career readiness, inclusion and showcasing based on the interview conducted with twelve K-12 spacemaker and they also found that the makerspace helped the student from becoming a consumer to being a creator. Studies conducted by [7] reveal that makerspace support innovation, creation of new enterprises and contribute to the affordability of prototyping.

Makerspace can be regarded both as a learning style or a teaching and learning method. As such, makerspaces

are physical confined spaces meant to be utilized for teaching and learning purposes. This medium can be traced back to the maker movement that promotes various learning styles such as tinkering, making, self-directed learning and collaboration. Lev Vygotsky, who developed the concept of Zone of proximal development(Z.P.D.) defines the distinction between what a learner can achieve without help and what learners can achieve with assistance [5]. Scaffolding is a process through which a teacher or more competent peer gives aid to the student in her/his Z.P.D. as necessary, and tapers off this aid as it becomes unnecessary, acting like a scaffold which is removed from a building during construction. Teachers/coaches or peers which are more competent will provide aid to the student in the student's Z.P.D. which refers to a process called scaffolding. The way the environment supports the users to collaborate with one another is closely linked to the theory of Zone of proximal development. This is done by scaffolding the users' knowledge and the understanding of the given problem by the more capable peers and teacher who act as a coach to them. Next section will discuss how potential makerspaces can foster creativity among industrial design students.

4. ADDRESSING THE NEED

Four scopes need to be addressed to implement makerspace in teaching and learning which are the involvement of all members, teacher/coach readiness, technology and material management as well as diversity of student's attitude [8]. The involvement of all members is one of the main recipes for makerspace as a resource and learning environment for students. In this regard, it will be a challenge for the teacher to ensure the involvement of all members present in making this goal possible. Other challenges that are considered significant in incorporating makerspaces into teaching and learning is the provision of instructors who have a deep understanding of the subject they wish to teach. Moreover, in order to unleash the creativity from the student, educators are expected to be more of a coach to students (active learning) rather than a technical expert and provides more general goals in the project given to them. Technology and resource management should also be emphasized as the makerspace's-teaching and learning process requires the use of a variety of tools that must be managed, supervised and maintained to ensure a smooth learning process. Next is the diversity of students' attitudes which is a significant challenge in the inclusion of the makerspace in learning. Each student has a particular attitude toward making that is considered severe and cannot be learned by them. This notion should be eroded with the support of the involved members to change this perception which in turn bridges the knowledge gap between the students and the field. In addition to that, the need for the addition of Project-based learning and design thinking methodology to be a part of the makerspace teaching and learning is to avoid the makerspace being tool-centric which in the long run will not define the real meaning of Design.

5. CONCLUSION

In conclusion, it is clear that makerspace has its most significant potential when combined with problem-based learning and design thinking which is crucial to foster creativity among industrial design students. This is important to prepare them to face the challenges in the 21st century design world and to become more creative, innovative, interdisciplinary and competitive.

By taking advantage of its vast potential, it is essential that project-based learning and design thinking methodology are applied in the environment of makerspace to ensure the suitability of this new teaching and learning approach to be embedded in the industrial design education and at the same time make us technological advancement taken from the maker movement community.

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REFERENCES

[1] S. Papavlasopoulou, M. N. Giannakos, and L. Jaccheri, "Empirical studies on the Maker Movement, a promising approach to learning: A literature review," *Entertain. Comput.*, vol. 18, pp. 57–78, 2017.

[2] N. Gershenfeld, *Fab: the coming revolution on your desktop--from personal computers to personal fabrication*. Basic Books, 2008.

[3] P. Blikstein, Z. Kabayadondo, A. Martin, and D. Fields, "An Assessment Instrument of Technological Literacies in Makerspaces and FabLabs," *J. Eng. Educ.*, vol. 106, no. 1, pp. 149–175, 2017.

[4] R. J. Sternberg, "The nature of creativity," *Creat. Res. J.*, vol. 18, no. 1, p. 87, 2006.

[5] E. Villalba, *On Creativity Towards an Understanding of Creativity and its Measurements*. 2008.

[6] J. R. Harron and J. E. Hughes, "Spacemakers: A Leadership Perspective on Curriculum and the Purpose of K–12 Educational Makerspaces," *J. Res. Technol. Educ.*, vol. 50, no. 3, pp. 253–270, 2018.

[7] E. J. Van Holm, "Makerspaces and Contributions to Entrepreneurship," *Procedia - Soc. Behav. Sci.*, vol. 195, pp. 24–31, 2015.

[8] A. Hira, C. H. Joslyn, and M. M. Hynes, "Classroom Makerspaces : Identifying the Opportunities and Challenges," 2014.