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**EFFECTIVENESS OF MOOCS IN STEM EDUCATION
FOR DEVELOPING VIRTUAL LEARNING**

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Abstract

In this complex world, our young generations need to develop a sense of knowledge and different kinds of skills in the fields of science, technology, engineering, and mathematics because it will help everyone to develop the nation forward and this is known as STEM education. This paper is focusing on the role of MOOCs in STEM education, here it is also explained how MOOCS plays an important role in helping the students for getting STEM education and also pointed out the measure MOOCS in the development of STEM education. The paper has explored the relationship between MOOCs and STEM in the field of education. It shows how virtual learning through STEM with the help of MOOCs can be more helpful in providing flexibility in the education system to the students as well as other stakeholders. It also examines the potential of MOOCs in improving learning experiences and facilitating interdisciplinary education in STEM fields.

Keywords- *STEM, MOOC, virtual learning, flexible education*

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INTRODUCTION:

The term “STEM education” refers to teaching and learning in the fields of science, technology, engineering, and mathematics; typically including educational activities across all grade levels, from pre-school to post-doctorate, and in both formal and informal classroom settings (Gonzalez, & Kuenzi, 2012). While scientific inquiry involves the formulation of a question that can be answered through investigation, engineering design involves the formulation of a problem that can be solved through constructing and evaluating during the post-design stage. STEM education brings these two concepts together through all four disciplines. **Nowadays online education occupies a vital position in the education system, not only but also from early times it has become a big part of our education through which everyone can get knowledge and skills through distance learning and in distance learning, online learning is the basis.** To make a distinction between MOOCs and the environment that hosts and delivers them, this paper refers to the learning environment (or the technology provider) as a Massive Open Online Education Platform (MOOEP). The year 2012 saw rapid development and expansion of several MOOEPs: Canvas, Class Togo, Coursera, edX, NPTEL, Udacity, and many others. The evolution and proliferation of MOOEPs can be attributed to the concept of ubiquitous learning – the idea that learning can occur anywhere and not necessarily in classrooms. Ubiquitous learning removes temporal and spatial boundaries in education and enables

continued growth and development of knowledge and skill.

STEM -In an ever-changing, increasingly complex world, it's more important than ever that our nation's youth are prepared to bring knowledge and skills to solve problems, make sense of information, and know-how to gather and evaluate evidence to make decisions. These are the kinds of skills that students develop in science, technology, engineering, and math—disciplines collectively known as STEM. The STEM education strategic plan *Charting a Course for Success: America's Strategy for STEM Education*, published in December 2018, sets out a federal strategy for the next five years based on a vision for a future where all Americans will have lifelong access to high-quality STEM education and the United States will be the global leader in STEM literacy, innovation, and employment. It represents an urgent call to action for a nationwide collaboration with learners, families, educators, communities, and employers—a "North Star" for the STEM community as it collectively charts a course for the Nation's success. The Department is an active participant in each of the interagency working groups focused on the implementation of the plan. Here this paper has focused on the role of MOOC in STEM education.

VIRTUAL LEARNING THROUGH STEM:

In the current scenario, everything can be easily done through online, and specifically, our education system becomes easier and more interesting through newly developed technology. Online classes improve interest among the students and help the teachers in their

professional development as well. It is quite credible that everything can be done within a few seconds which had taken much more time before in traditional teaching-learning situations. All students must be a part of the STEM vision, and all teachers must be provided with the proper professional development opportunities preparing them to guide all their students toward acquiring STEM literacy. By focusing on student engagement, educators from institutions of higher education and K-12 schools can work together to develop pedagogical models that provide a rigorous, well-rounded education and outstanding STEM instruction. STEM helps the learner as well as stakeholders to grasp the knowledge and skills in their different fields. Bybee (2013) clearly articulates that the overall purpose of STEM education is to further develop a STEM literate society. His definition of "STEM literacy" refers to an individual's [1]:

- Knowledge, attitudes, and skills to identify questions and problems in life situations, explain the natural and designed world, and draw evidence-based conclusions about STEM-related issues.
- Understanding of the characteristic features of STEM disciplines as forms of human knowledge, inquiry, and design;
- Awareness of how STEM disciplines shape our material, intellectual, and cultural environments; and
- Willingness to engage in STEM-related issues and with the ideas of science, technology, engineering, and mathematics as a constructive, concerned, and reflective citizen."

ROLE OF MOOC IN STEM:

Online learning becomes an integral part of the education system which helps in reshaping the education system in a new form. A MOOC is a free web-based course with open registration, a publicly shared curriculum, and open-ended learning outcomes. Recent versions of MOOCs are built upon traditional online learning techniques but, scaled to a large number of students and backed up by a strong technology medium. This resulted in two categories of MOOCs: 1) Connectivism-based MOOCs, called cMOOCs, and 2) MOOCs that are extensions of conventional online courses, called xMOOCs [1].

MOOC offers different courses at all levels from preparatory courses to graduate and higher levels. The duration of courses varies from 4 to 14 weeks (approximately). Most courses are either archived after completion or scheduled to be offered again. Students can supplement their formal education by enrolling in a MOOC that is similar or equivalent to a classroom-based course to reinforce concepts or to develop a different perspective on certain topics.

It has focused on- **Cross-disciplinary Education and Research, Supplemental Learning, Teaching Techniques, Non-technical Skills, Student Assessment** which are innovatively enhanced STEM education.

Lectures are divided into several small videos that are 10 to 25 minutes long. This allows reflective learning by allowing students to comprehend the content that was presented. Most video lectures have integrated quiz to emphasize key concepts. In most of the courses offered by the different colleges and universities, there

are some certain standard rules for getting admission into courses and having some fixed period which is not possible for all in appearing that kinds of courses but getting knowledge in STEM education becomes an integral part of our life and in this busy schedule MOOC is the one which gives the appropriate field to all for having such kinds of courses without any condition, through this anyone can get knowledge in anywhere regarding STEM education not necessary for taking admission in general courses in the particular period also. For example, many biomedical engineering projects require skills from different fields that include, but are not limited to, mechanics, computing, electronics, clinical engineering, product development, and industrial design. Students can acquire the necessary skills and knowledge that are needed for their research by enrolling in appropriate open online courses.

In STEM education, not only the skills for content but also skills for other activities are necessary like communication skills, skills on technology, in an engineering field, etc which can be adopted by MOOC platform, it will be helpful to engineer as well as science students in their field. MOOC focused on almost every field from learning style to learning outcomes of the learner, it built a learning environment through collaboration, it organizes some quizzes, discussion forum, etc so that no one can get bored in the learning process. In some videos, it has been focused on the assessment process in which it assesses the student's performance innovatively. As it is assessing more than 10,000 students at once so it is not assessing through like exams, it assessed students through peer assessment and quizzes, etc.

RESULTS AND DISCUSSION:

In online learning, MOOC plays an integral role and for developing virtual learning through STEM, MOOC plays an important role. In this paper, MOOC and STEM are not shown like in real classroom learning but it is supplement of the classroom learning for the learners. Besides technical competency, STEM-related industry jobs often require some non-technical skills like writing, public, speaking, business acumen, leadership, and management skills. These skills are needed for technology and engineering students who are looking to pursue entrepreneurship or join a start-up company. It is not surprising that there are business, management, and humanities-related courses in the MOOC world to fuel the interests of aspiring entrepreneurs in STEM disciplines. STEM education provides an equal chance to all four subjects, it reflects interdisciplinary knowledge and MOOC helps here for getting this knowledge and skills through virtual learning which is very much helpful to all in the current scenario. The American Council of Education (ACE) has already initiated a review process to evaluate a few massive open online courses for possible college credit recommendation [5]. All the courses that are currently being considered by the ACE College Credit Recommendation Service (ACE CREDIT®) are fundamental STEM-related courses. In the future, it may be possible for students to use these supposed MOOC credits towards their actual college degree [1].

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