Factors Extraction of Effective Teaching-Learning in Online and Conventional Classrooms

Tanu Shukla, Divya Dosaya, V. S. Nirban, and Mounika Prashanthi Vavilala

***Abstract*—Integrating technology in education through online courses can enhance the learning experience when coupled with the traditional methods of interaction. Online courses can help in providing access to education to people from remote and marginalized sections of the world. They help in developing critical thinking and increasing the capacities of students necessary for the 21st century. There has been a shift from traditional classroom teaching to teaching in a hybrid or blended manner. An online learning environment creates a potential learning space for students to use technology for effective teaching and learning process. A well-designed learning environment can blend conventional methods with technological innovations for increasing the accessibility and efficiency of the education system. The study collected data from graduate students (*N*=220) on various determinants of effective online courses and learning. Correlation was used to explore the relationship of the dimensions with the construct of effectiveness. Factor analysis was done and two factors were extracted, namely, student attributes, features of the platform and instructor quality. The findings of the study provide insights for measuring the effectiveness of online courses and initiate measures to handle the challenges to online education.**

***Index Terms*—Online learning, effectiveness, technology & education.**

I. Introduction

Advancements and mushroom growth of online learning platforms have caused many groundbreaking alterations to the classical approach to education. Online learning courses have increased the accessibility of course content to students in remote and under-developed regions, reducing the economic gap and education inequalities, and enabling them to learn at their own pace and get connected to teachers from different parts of the world. The current trend in using online learning courses is estimated to continue to grow with millions of users around the world. Some of the significant features of the online learning platforms are: flexible in viewing content, anytime accessibility, compliant assignment submissions, and open book evaluations. Students from different socio-economic backgrounds and time zones can access content on the massive open online courses. Online learning involves the use of computer-assisted instruction methods, either through synchronous (real-time), asynchronous learning (e-mails, newsgroups, etc.) or online courses. Online learning is student-centered, enables collaboration, access to global resources, learning through multi-media presentations, and helps in capturing the interest of students. Online courses are delivered over the internet, using a combination of teaching strategies such as blended learning where one-to-one learning along with using technology or learning over the internet [1]. The traditional methods have been replaced, bringing a radical change with online learning technologies and methodologies for effective learning [2]. The driving societal forces that have been identified to contribute towards online learning are student flexibility; learner effectiveness; less administrative support and meeting the growing competitive demands through innovative online learning platforms. There have been continuous efforts to evaluate the usefulness of e-learning. Some of these have been researches that focus on the technological components [3] while others have focused the human factors of the e learning systems [4]. An unexpected side effect of this flexibility in online learning is the high percentage of students who drop out of a course as the content is available anytime for the future [5].

Blended Learning and its effectiveness involve some barriers. A major barrier being successful use of technology and maintaining the users' commitment throughout the course against personal learner characteristics and experiences with technology [6]. Most of the universities have not yet integrated MOOCs along with conventional methods. The number of students enrolling in a course gives no real information other than the fact that many students felt that the course would be interesting. Similarly, the dropout rates need not necessarily mean that there is a problem with the way the course is structured. Although lot of students enroll for the courses, the completion rate is low and a lot of students dropout. The voluntariness and lack of serious-environment make it difficult for universities to offer MOOC courses. This paper attempts to understand the factors influencing the effectiveness of the online learning environment, perception of students about the usage and effectiveness. The findings from the study can provide insights for designing the content according to the needs of the participants.

II. Literature Review

Several studies have been identified to understand the determinants of effective online learning. Online courses were classified into categories based on their design, delivery, assessment, and summary of challenges [7]. The success of the online course has been attributed to the students' reception towards the content and relevance of the course. The interest groups of an online course are the students, teachers and the administrator or the planner of the course [8].

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A study was conducted to understand the importance of flipped classroom in a course on control systems, which found that social assignments to be important for learning the course content [9]. Students in a social learning space can learn the content effectively by applying the knowledge through projects and assignments. The appearance of captions is complementary to the video courses. Lectures which included quizzes at the end of the session were found to be more efficacious [10]. Videos that were short and more visual in nature were most preferred among the students [11].

The massive online learning courses are aimed at increasing participation, enhance the quality of interaction, increasing accessibility through collaboration between the learner and instructor from different parts of the world [12]. These courses allow participation in large numbers and being open can mean that it allows enrollment, ie, open enrolment, of students from different institutional affiliation and educational background. An online course is considered as a MOOC when it satisfies the criteria of having course content specific to certain objectives, learning outcomes to ensure knowledge transfer mediated through technology [13]. Innovation is essential in the developmental stages of individuals. The idea of innovative education emphasizes on translating knowledge into action, creating, modifying, intervention through systematic process. It involves integrating technology, people, pedagogical processes and classroom interactions [14]

An empirical study investigated universal design learning. Universal design, defined as designing something based on aesthetics, utility enabling increased access and ease of usage [15]. Learning environments need to be designed to increase access to diverse learners integrating resources, curriculum, pedagogy, and flexibility in design, reduce the barriers to education [16]. The user interface of online learning content plays an important role. The interface should be designed to improve and personalize management, delivery, efficiency, and evaluation of the courses at the individual level [12]. Adaptive User Interface in online courses is used to assess the knowledge of students at the entry level and after the course. Here, the adaptive platform is used to assess the performance of students after every module to determine whether to hide or show the next content [17]. The adaptiveness of content helps in understanding the student needs and providing relevant content according to their level of achievement. Course content based on the student's previous test scores and priorities helped students to concentrate and perform better [18].

Collecting feedback from students regarding their personal goals behind attending a course can provide insights for developing content, design, delivery, and assessment of the interface. Learning analytics can also provide invaluable data on the learning profiles of diverse participants. So far, the existing online course environment has shared little information on their usage patterns. Inclusion of software agents in MOOC can experience noticeable improvements in content quality, course delivery, less dropout rates, better participant support, and enhanced evaluation methods [19]. Learning styles can affect the motivation of participants to continue a course and integration of learning techniques in the design and implementation of the courses can influence the dropout rates of participants [20]. The study identified strong preferences towards active, visual, and sequential learning styles among students. Variability and Interactivity supported by new technology and learning styles help in increasing the quality of learning.

Some of the features that were identified for developing online courses are student experiences; outcomes; policy and format of the platform. The extent of social relevance and aspects are largely overlooked in design and implementation. Precise Effectiveness Strategy (PES) could be used as a generic methodology for defining the parameters to measure the effectiveness of online learning platforms such as MOOCs and SPOCs. The raw data captured during the course through case studies can be assessed based on the quality of interaction between the participant and the instructor; effective usage of the educational resources and course evaluation components for better learning such as quizzes, projects, and assignments. An analysis of pre and post-test evaluations of the course can provide an understanding of student learning. The achievement levels of students can be used to give feedback and make changes in the course content and design. It can provide valuable insights for improving the design, instruction, and implementation [21], [22].

Institutions adopt MOOCs for several reasons, such as extending reach and access, building an image or brand value, improve economics, increase revenues, improve educational outcomes, explore innovation through technology integration & research [22]. The online courses enhance the quality of life of individuals by providing lifelong learning opportunities, favoring cognitive stimulation, accessibility, sense of belongingness and engagement in academic activities [13]. The challenges include pedagogical opportunities, designing online open courses, exploring issues of accreditation, quality assurance and the digital revolution in education are still nascent, and data is often misleading [23]. The effectiveness of online courses in distance education was measured based on three elements namely, social presence, cognitive presence and teaching presence [24]. Based on the theory of critical thinking, the inquiry triggers students to explore, understand and investigate. Further enabling students to reflect, construct meaning or develop ideas and gain new knowledge. When students get active in discussions and forums, it facilitates in triggering their cognitive learning activities, self-confidence, and performance [25].

Social presence in the online environment involves one's ability to establish their presence in a virtual environment through participation in various discussions, forums, group tasks, and develop a presence in online environments [26]. One can form virtual cliques, relationships and know people from different parts of the world [27]. Social connectivity develops critical thinking, improves learning performance and satisfaction and learning outcomes of students [28]. The usage of educational technologies increased success and reduced the gaps in accessibility of students from different socio-economic backgrounds [29]. Frequent interactions between the students and teachers attributed to better online education experience, improved learning, and student outcomes. The study emphasized on the type and quality of

online courses made available to students who are not academically prepared and have limited resources. Student engagement in online courses can be determined through the following measures: i) regular feedback and instructions from the instructor; ii) interactive, dynamic platform and easy, user friendly interface [30].

Hybrid classrooms were found to be more effective as compared to traditional blackboard classroom and completely virtual classrooms [31]. Blended courses have been observed to increase student performance as compared to the non blended courses [32]. Blended learning can also be used as a tool to decrease disparity between academic achievement of male and female students [33]. Kintu & Zhu [34] found that learners' attitude towards blended learning significantly contributed to learner satisfaction and motivation.

An effective online learning platform is characterized by well-designed course content; motivation; effective pedagogy: strategies and catering to the needs of diverse students; professional development; participation in discussions and forums; creating an online community, and feedback [24]. Online learning may be a viable avenue for people who are interested in a particular topic to learn something but are not interested in gaining a credential. The online learning platforms cannot replace the traditional learning methods of blackboard teaching but can increase access to education and provide support in improving the quality of teaching and learning process. Based on the literature review, the study identified the determinants to measure the effectiveness of online learning content and the environment. The objectives of the study were to explore the relationship of the total effectiveness of online learning with the dimensions and to identify the factors influencing the effectiveness of online learning courses.

III. Methodology

The study was conducted on graduate students (N=220), using a random sampling method from one of the engineering institutes located in northwest India, where the blended online courses involving a combination of face to face and online interaction between the student and the instructor is used for learning. Based on the review of literature, the factors influencing effective learning in online or blended learning courses were identified, and a questionnaire was formulated to measure the effectiveness of the online courses. The explored dimensions of effectiveness are Course Orientation, Instructor Quality, Collaboration and Deliberation, Student Motivation, Engagement, User-Friendly Interface & Feedback, Resources, Assessment, and Commitment. To establish the relationship between the variables, Pearson correlation was used to analyze the data. Using principal component analysis (PCA), two factors were extracted which majorly contributed to the construct of effectiveness.

IV. Analysis of the Data

The data were analyzed to find out the relationships among Course Orientation, Instructor Quality, Collaboration and Deliberation, Student Motivation, Engagement, User-friendly interface & Feedback, Resources, Assessment, Commitment and total effectiveness scores of online learning using Pearson correlation method. Significant positive relationships were found between the dimensions and total effectiveness measures.

TABLE I: Pearson Correlation Results Table

DIMENSION	r VALUE
D1: Course Orientation	.470**
D2: Instructor Quality	.517**
D3: Collaboration and Deliberation	.723**
D4: Student Motivation	.662**
D5: Engagement	.869**
D6: User Friendly Interface & Feedback	.421**
D7: Resources	.533**
D8: Assessment	.492**
D9: Commitment	.427**

**p<0.01

Table I indicates that with adequate, relevant information sharing before the course, ensuring instructional quality and through effective classroom management strategies, student learning can be increased. Student attributes such as motivation, participation in discussions, groups and forums enhance their social and cognitive presence. Simple user interface designs, ensuring the availability of resources, technological support and commitment would increase the effectiveness of online learning. Systemic barriers such as course design, usage of different multimedia modalities, defining the learning goals and learner analytics were found to influence the quality of instruction and reduce dropout rates [35]. The online learning environment can enhance student learning. Decision making and enabling agile action towards new technologies can facilitate better learning among students [36].

The nine dimensions measuring the effectiveness of the online courses were subjected to exploratory factor analysis (EFA). Principal Component Analysis (PCA) was used in the study as it is recommended when no priori theory or model to measure a construct exists [37]. Pett *et al*., 2003 [38], suggested using PCA in establishing preliminary solutions in EFA, followed by varimax (orthogonal) rotation method. The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis, KMO=.86, and all the KMO values were greater than .70, which is well above the acceptable limit of .50. The values of Bartlett's test of sphericity was found to be highly significant (p<.001), indicating that correlations between dimensions were sufficiently large for PCA [39]. These values also supported the factorability of the matrix [40]. Scree plot, uses the eigenvalue =1 to visually represent the components or factors on a graph explaining the variability in the data. All the items were having communality values higher than .30.

Scree plot and Kaiser's Eigen Value greater than one were used as criteria to determine factor extraction. The scree plot led to the extraction of two factors. Table II depicts values of

communalities which describe the proportion of each variable's variance that can be explained by the factors. The rotated factor loadings, for dimensions 1, 3, 4, 5, 6 and 7 were loaded in factor 1 and dimensions 2, 8 and 9 loaded in factor 2. Factor 1 consists of student attributes and aspects of online course platforms, whereas factor 2 is inclusive of instructor aspects of the quality of online learning. The analysis was useful in reducing nine dimensions into a cluster of two. Course orientation explained the maximum variance in the data.

TABLE II: FACTOR LOADINGS

DIMENSION	FACTOR 1	FACTOR 2
D1: Course Orientation	0.94	
D2: Instructor Quality		0.751
D3: Collaboration and Deliberation	0.619	
D4: Student Motivation	0.711	
D5: Engagement	0.652	
D6: User Friendly Interface & Feedback	0.651	
D7: Resources	0.708	
D8: Assessment		0.571
D9: Commitment	0.577	

Providing Course Orientation in an online course can help in increasing its effectiveness. This enables the students to know precisely what they would learn; what is expected of them, and how much effort they need to put in. The internal consistency of the scale was (α = .89) [41], [42], which was found to be good. Efficacies of online learning platforms such as the access, quality and cost framework of learning were explained to increase learning efficiency [43]. The study identified characteristics that can enhance the quality of teaching learning such as classroom strategies congruent with student needs; using different learning styles; making the course easy to access, use and understand; student-centric approach; skill development and adequate resources.

Collaboration and deliberation through interactions with peer group and instructor is essential as the communication can help the individuals to learn, receive feedback and engage in active learning [30]. Learning effectiveness is determined by the motivation, engagement and online participation of individuals [44], [45]. Learner motivation can be enhanced by having a clear course structure, ensuring pre course orientation, establishing purpose and learning outcomes, providing adequate support. Self-directed e-learning through intrinsic motivation, exercising learner autonomy, and agency can ensure optimistic learning experience and student engagement [46], [47].

Teachers with higher self-efficacy exhibit a higher level of innovative behavior in terms of technology usage in the teaching and learning process [48]. Student-teacher interaction, leveraging technologies can increase the motivation, interest, and engagement of students for classes [49]. It also facilitates creating positive learning spaces with adequate resources and capacity building [50]. It is essential to make the platform sustainable, dynamic and relevant.

Incorporating the principles of social constructivist theory, a successful online platform requires a strong learning community and building learning network through collaborative learning, interactive platform for group facilitation and dialogue [51], [52]. Assessment in Online courses should be fair, equitable and incorporate qualitative assignments that facilitate students to apply their real-life skills and processes; engage in active learning and feedback on their learning progress and tutoring [53]-[55].

Online learning platforms are interactive platforms of for knowledge dissemination, helpful for individuals to learn and get credentials but they do not replace the face-to-face teaching and learning. Student learning outcomes in online courses may not be equivalent to the on-campus course. The effectiveness of an online course and ensuring student learning outcomes would be dependent on the quality of the course, user interface design, teacher characteristics, learning-focused activities and student characteristics. Providing proper feedback, encouraging learning networks, providing flexible structure, material and support are essential to retain students and ensure course completion [56].

V. CONCLUSION

The findings from the factor analysis confirm that the two factors with nine dimensions explained the significant proportion of variance in measuring the effectiveness of online courses. Investing in building a learning platform with sufficient resources, trained professionals to effectively integrate technology in education can help in increasing accessibility and usage of online learning platforms for knowledge acquisition, skill development and build their competencies. Incorporating suggestions, using different strategies and using engaging content can increase the interest and motivation of students to complete the courses [35]. The findings of the study emphasize on increasing participation through cognitive and social presence, such as extensive use of discussions, forums, enabling ease of use through short duration lectures and tasks. Further, to create critical learning spaces that can foster self-understanding, creativity, problem-solving abilities and capacities among students. The study provides insights for creating an online or blended learning environment and determinants to measure its effectiveness. Literature shows that there exists dearth of efforts in the direction of understanding and use of theory as a base for blended learning research. Research in blended is equally important to both the educational technology and the distance education fields. The study can be extended across various disciplines, and in-depth qualitative research can be conducted to substantiate the findings.

CONFLICT OF INTEREST

The authors declare no conflict of interest

AUTHOR CONTRIBUTIONS

Dr. Tanu Shukla has conceptualized the study and designed the methodology of the research. She has formulated the questionnaire and has extensively worked on data analysis and interpretation of the results. The paper was continuously edited under her guidance.

Divya Dosaya has contributed in writing the introduction

and literature review of the study and also assisted the co authors in writing the research methodology and the results of the study.

Dr. V. S. Nirban has supervised the paper writing and editing process throughout. He has played a role in giving a direction to the literature review. He has also supervised editing of the paper throughout the publication process.

Mounika Prashanthi Vavilala has contributed in writing the results of the study. She has also assisted in the review process throughout develoing the paper.

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