HYBRID LEARNING: INTEGRATING PROJECTS, MOOCS AND VIRTUAL LABS IN TRADITIONAL CLASSROOMS FOR UNDERGRADUATE STUDENTS

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ABSTRACT

Hybrid learning (HL) is an ongoing convergence of traditional learning with technology-enabled online platforms. It is currently referred to as the ‘new normal’. HL is, therefore, aimed at providing the most efficient and effective teaching experience by combining diverse delivery modalities. This paper aims at reviewing the integration of Project Based Learning (PBL), Massive Open Online Courses (MOOCs) and Virtual Lab (VL) into the traditional undergraduate (UG) curriculum.

Key words: Hybrid learning, Project Based Learning (PBL), Massive Open Online Courses (MOOCs), Virtual lab

INTRODUCTION

The teaching learning environment is currently evolving by integration of a number of innovations, most of them involving the use of technology through hybrid learning (HL). This new pedagogical approach is being appreciated by teachers and learners alike and is rapidly gaining popularity. A US based study defined HL as “a combination of online and in-class instruction with reduced in-class seat time for students”. It also has different names like mixed learning, blended learning, blended e-learning, melted learning, etc. The aforementioned study established that 35% of higher educational institutions (HEIs) offered blended courses and 12% of the 12.2 million documented distance education enrollments were in blended courses (Kintu et al, 2017; Dziuban et al, 2018). The methodology behind HL is to combine classroom learning with online learning, creating a flexible and effective model for instruction which can be asynchronized and synchronized. Asynchronized courses can be applied using the Learning Management System (LMS) wherein learners can access recorded videos/study material, submit their homework and projects through this system. In the synchronized section of online courses, students are required to join the class at a specific time for live streaming of content that can be followed interactively, independent of location (Yigit et al, 2014; Listiana & Jaharadak, 2019).

This paper aims at reviewing the advantages and challenges of HL through the integration of Project Based Learning (PBL), Massive Open Online Courses (MOOCs) and Virtual Lab (VL) into the traditional curriculum of undergraduate (UG) students.

PROJECT-INTEGRATED LEARNING

PBL has been in the realm of education for the past fifty years. Its implementation in educational settings has promoted collaboration, problem-solving and independent acquisition of new knowledge. With changes in education (e.g. flipped classroom, online courses and students in charge of their own learning journeys), there has been a natural move towards the utilization of technology (Green, 2018). PBL enables students to acquire knowledge that is retrievable and usable, develop cognitive skills appropriate for reasoning and equip them with self- learning skills. Project integrated learning is an attempt to blend PBL with face-to-face (F2F) learning in order to optimize the advantages of both methods (Klentiena and Wannasawadeb, 2016).

In PBL, the teacher acts more as a facilitator to student learning than being in complete control. With students at the forefront of this style of learning, teachers are able to engage and motivate learners. Students can use their own preferred technological tools to solve problems and show their understanding of topics. This would enable students in easy understanding of science lessons, completing experiments in less time and creating new experiments. The combined use of F2F and PBL could together be considered as a formidable combination that are complementary (Donnelly, 2010).

There is a growing body of research suggesting PBL to be more effective than traditional instructions. In our previous survey-based research with 126 participants, impact of introduction of PBL, to an otherwise traditionally taught undergraduate practical program, was correlated to various graduate attributes and learning outcomes. We found an overall increase in different skill sets achieved, of which laboratory skills ranked the highest. A significant difference in the competencies was observed between semesters with respect to communication skills and understanding of research papers. The total skill sets developed were found to be a function of the number of individuals involved in the research group. According to 90% of the respondents, the option of selecting a research topic/guide could have a better impact on learning attributes (Yoosuf et al, 2020). Similarly, Strobel and van Barneveld (2009) found PBL superior in terms of retention, skill development and satisfaction of students/teachers than traditional approaches. Solving research problems via asynchronous discussion forum can be effective in inculcating critical thinking (Listiana and Jaharadak, 2019).

However, enthusiasm of teachers is an essential ingredient for successful implementation of such blended technologies. Similarly, students need motivation and incentives in terms of credit for their constructive contribution to the discussion to positively respond to the use of new technological pedagogies.

MOOC-INTEGRATED LEARNING

MOOCs are open web-based courses for self-motivated individuals offering a cost-effective route for their professional development (McAuley et al, 2010; Hill, 2013). As Kay et al (2013) summarizes, MOOC requires the instructor to design a curriculum taking into account the need for new knowledge and competencies, and formal learning goals for accreditation/certification. For this, the instructor creates learning materials that the students will actually see and interact with. This involves making video snippets, short pieces with the lecturer's face visible and other supporting material including annotations. The lecturer also creates self-test formative quizzes as well as larger assessment tasks to reflect on the students' understanding.

HL models in higher education do not have to be developed around MOOCs. However, there is a growing interest in exploring how MOOCs can enrich traditionally taught courses acting as a complementary resource in achieving teachers' and students' goals. Bralić and Divjak (2018) studied implementation of the HL model by integrating MOOC in a traditional classroom to understand student experience based on their learning outcomes. They inferred that students appreciated the self-paced learning model that created a tendency of self-study and leveraged more frequent knowledge checks. They also noted that HL takes the best out of two worlds accommodating different learning needs, styles and preferences. It presented an opportunity to wrap on-campus courses around existing MOOCs aiding the students to choose a MOOC that covers practical implications of classroom taught courses.

Individual colleges and universities have now begun accepting MOOCs, such as SWAYAM, Coursera, EdX, Udemy, Khan Academy, Udacity etc, for credit with faculty approval on completion of an assessment, benefiting students to gain credits for exams taken outside traditional degree programs and encouraging them to take more MOOCs. Many universities have also announced agreements to license MOOC content for inclusion in campus-based courses. This enables the campus faculty to retain a high degree of control over course content and grant of credit (Sandeen, 2013).

A similar approach to HL has been adopted by our institute in order to encourage the students to undertake various online courses across semesters. The platform chosen is SWAYAM-National Programme on Technology Enhanced Learning (NPTEL), which is an initiative funded by Ministry of Human Resource and Development (MHRD), Government of India coordinated by IITs and IISc. NPTEL offers more than 400 courses per run including FDP courses. Also, suggestions regarding the introduction of new or re-run courses, aligned with the curriculum, conveyed through a SWAYAM coordinator is duly implemented by NPTEL. We, as a local chapter, have been offering additional credits, as per UGC guidelines, to students as incentives for completing these courses. Besides this, the institute also felicitate and acknowledge the excellent efforts of the course toppers as well as top-performing mentors, thereby, motivating students and faculty alike. Mentors and course instructors have noticed a striking difference in performance of students who undertook these courses as compared to others in their regular and competitive exams. However, we are yet to quantify the results to ascertain the impact in clearing entrance exams and securing admissions in institutes of national and international repute.

Despite the momentum, sceptics of MOOCs are also widespread, with completion rates of these classes being dismal compared to traditional education (Zhong et al, 2016). A decline after an initial increase in the percentage of students who opted in for a MOOC after its implementation has been noted (Bralić and Divjak, 2014). Many contributing factors can be the unidirectional flow of knowledge, poor instructional quality, non-availability of on-line laboratory sessions, lack of glossary of key terms/abbreviations, absence of personalized monitoring and the internet penetration in rural areas. The poor instructional quality of MOOCs can be attributed to inadequate knowledge of contemporary instructional design principles/theories or inability to implement it in the MOOC setup (Bhattacharjee, 2014; Margaryen et al, 2015; Zhong et al, 2016). Also, in order to support technical course development (e.g. video capturing and editing, assignment specification), one requires to build on a good many years of research on, and experience with developing courseware tools and e-learning software (Horton and Horton, 2003). Nevertheless, Bruff et al (2013) advocates more complex forms of HL in drawing course materials from multiple MOOCs and other online sources. Information and communications technology (ICT) aided with the growing popularity of smartphones and tablets to access online digital resources enable interactions in an always-connected society that boost the MOOC usage (Chen, 2013).

LEARNING INTEGRATED WITH VIRTUAL LABS

The laboratory sessions are vital components for STEM courses to apply theoretical knowledge to practice. Costly equipment and resources, non-functional instruments, physical distance, inadequate time, hazardous materials and limited expertise often put constraints on performing traditional hands-on experiments (Zumbach et al, 2006). Exaggerated focus on memorizing facts, listening to lectures and performing ‘cookbook’ laboratory exercises also result in graduates with marginal competencies (Honey and Hilton, 2011). However, ICT-enabled VLs have addressed these problems by providing online learning through computer-aided instructional materials in the form of animations, simulations and remote-trigger experiments. VL is one of the most evolving trends in blended learning embracing the concept of “learning by experience” where learners are encountered as actors rather than passive information receivers (Dutta and Bhattacharjee, 2019; Efstathiou et al, 2018). These allow for virtual technical directions, high degree of interactions with objects and manipulations of parameters for scientific understanding. One of the major factors supporting the use of VL is the ability to gather data quickly and accurately. This implies that more time can be spent on analysis of the data addressing the underlying concepts required to stimulate natural curiosity for autonomous inquiry-based learning (Galan et al, 2017).

With an objective to increase remote-access to labs in geographically distant and economically constrained areas, a number of VLs have been developed by institutes across the world. NASA’s virtual laboratory, iLabs by MIT, The ‘VITAL’ Lab by Ohio University, The Virtual ChemLab, JoVE, LiLa and Labster are few of the global paradigms. Besides these, MHRD, Govt. of India through National Mission on Education through ICT (NME-ICT) launched “Virtual Labs” project (http://www.vlab.co.in) to develop more than 180 VLs in biosciences and engineering courses.

The concept of VLs was also introduced in the curriculum for UG engineering & technology courses by AICTE in 2018 (Dutta and Bhattacharjee, 2019; Ramesh, 2019).

In a detailed study, Diwakar et al (2014) analyzed the role of VLs in imparting quality education among UGs in urban and rural areas across India. Students supported that VLs allowed them to familiarize with the basic techniques in par with regular theory classes, demonstrated the use of sophisticated and complicated instruments, and enhanced their performance. It was inferred from teachers' feedback that VLs were effective in overcrowded laboratory sessions due to accessibility and served as a supplementary tool to make the education easier and interesting. Almost 95% of participants supported that UGC and AICTE approved curriculum has been covered in VLs leading to an interest in using these for conducting students' evaluation. Additionally, these were user-friendly and provided good online material for effective understanding of the concepts. In another study, Bonde et al (2014) highlighted the importance of gamified laboratory simulations in motivating students and improving learning outcomes as compared to traditional teaching methods. Combining a scoring system and gaming elements, such as an immersive 3D universe, storytelling and conversations with fictional characters, in laboratory simulations provided an opportunity for a high level of perceived learning and self-efficacy (Bonde et al, 2014). Eastwood and Sadler (2013) also observed high learning outcomes, particularly in lower-level students, with implementation of a 3D educational game, Mission Biotech.

Despite VLs being very efficient in the e-learning process, the concept is associated with some limitations too. No real hands-on activities, lack of monitoring, no concept of good laboratory practices, over-simplified mediocre designs, ineffective replication of realistic lab environment, lack of natural variations, challenges and troubleshooting, minimal learning outcomes, unrealistic simulations, inadequate infrastructure and internet connectivity in rural areas, etc. are a few of them. Reluctance of teachers and educational institutes also hampers in realizing the full potential of this technology (Frerich et al, 2014; Chandrashekhar et al, 2020). Although there is still a long way to achieve the desired integration of virtual technologies with the evolving pattern of curriculum in HEIs to bring out the true nature of HL, it is important to note that, with VLs, students can gain invaluable experience with lab techniques that would otherwise be unavailable to them. These expand the traditional F2F lessons in class motivating the learners to actively participate and construct knowledge. In online classes, study material can be consolidated on a

LMS and supplemented with digital learning tools. Lastly, in unprecedented times, students can design and test their own theories, via VLs, within a safe environment.

CONCLUSION

When HL is understood and applied carefully, it offers great advantage for both students and teachers**.** However, there are no specific characteristics or standardization methods used in mixed learning models (Shahabadi and Uplane, 2015). Since the outcome of integrating PBL and MOOCs to our UG curriculum was quite encouraging, we plan to gradually introduce VLs into our UG practical curriculum. In our model, we propose a combination of F2F and e-learning framework wherein main topics can be taught traditionally and others online via synchronous and asynchronous mode. Some points to be specifically noted are: (i) Content cannot be imitated from a F2F learning to an online setting. It should be learner centric that allows for student-student as well as student-teacher interaction, (ii) In F2F learning, social interactions increase student motivation; however, in e-learning, interaction must be initiated through synchronous/ asynchronous facilities to encourage student engagement and motivation, and (iii) The transfer of direct course materials to the digital platform may pose a major pedagogical challenge to many teachers. Therefore, the teachers must receive specific training in e-learning pedagogical delivery to understand students' learning process and enhance their participation. To optimize the learning process, instructors must be good communicators as well as listeners. They must go an extra mile in preparing and delivering course materials that will not only engage the students but also motivate them.

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