Blending Active Learning in a Modified SPOC Based Classroom

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Abstract

Blended Learning is an amalgamation of face-to-face and e-learning. MOOCs (Massive Open Online Courses), a popular e-learning source of rich quality content produced by best instructors are freely available to learners globally. However, MOOCs suffer from high attrition rate. Hence, to utilize the available resources efficiently, SPOCs (Small Private Online Courses) came into existence. SPOCs combine the student centered resources with instructor centered traditional classrooms. However, SPOCs still require self motivated students. To explore the potential of SPOC, we offered a university course as modified SPOC and applied techniques of active learning in classroom. We study the impact of the course on students' learning by conducting surveys and monitoring their progress throughout the course duration. Our results show online resources, specifically videos, can be used successfully to enhance learning in traditional classrooms. Our results also depict marks as prime motivating factor for students' efforts.

This Thesis work is dedicated to my family for their endless love and support.

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Declaration

This is to certify that the MTech Thesis Report titled **Blending Active Learning in a SPOC Based Classroom** submitted by **Shruti Bansal** for the partial fulfillment of the requirements for the degree of *M.Tech.* in *Computer Science* is a record of the bonafide work carried out by her under my guidance and supervision at Indraprastha Institute of Information Technology, Delhi. This work has not been submitted anywhere else for the reward of any other degree.

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1

Introduction

Over the years, various pedagogies such as active learning, e-learning have been extensively researched to actively engage students and enhance learning outcomes. Technological advancements have also played a key role in reshaping the existing pedagogies and presenting avenues for development of new pedagogies and frameworks. Bonwell et al. defined active learning as anything that "involves students in doing things and thinking about the things they are doing" [1]. Active Learning is prevalent in instructor centered traditional classrooms. Instructor is responsible for setting the pace and direction of instruction. While this pedagogy results in improved motivation and goal achievement within the classroom, it consumes much of instructor's time and efforts, leaving little or no scope for deeper learning or personalized attention to students. On the other hand, proliferation of MOOCs has provided learners to guide and motivate their own learning outside the traditional classrooms, thereby enhancing e-learning. MOOCs are a rich source of content, providing learners access to latest educational resources at their own pace. However, learners lack external constraints such as exams, grading policy etc which leads to high attrition rates in MOOCs [2, 3, 4]. The onus is on students to engage with the material effectively to achieve their learning objectives. This has prevented learners to effectively utilize MOOCs to their full potential. Fox presented a model "SPOC" to effectively utilize the MOOC resources by incorporating them in traditional classrooms [5]. SPOC is a step in making traditional classrooms student centric. Students have access to high quality course material and rely on instructor for guidance. Instructors can make use of available time to engage students in active and deeper learning in classrooms. But, students still have to rely on themselves

for motivation and goal achievement to complete the SPOC, which is usually assigned as homework. This provides us many opportunities to enhance classroom learning.

We conducted a course in blended format by combining a modified SPOC with techniques of active learning. The aim was to study the learning outcomes in a student centered SPOC with instructor acting as guiding and motivational source. The classroom sessions were used to engage the students with course materials by leveraging active learning techniques such clickers, student presentations, code walk-throughs. The results of our study show high student learning and satisfaction by use of online resources. However, students' efforts are guided by marks more than the desire to learn. Even though students found different course activities such as use of clickers, student presentations etc. beneficial, their participation was result of novelty associated with the activities, which eventually declined. Our results also indicate instructor's presence is a motivating factor in classroom even when they are not actually delivering the lecture.

2

Related Work

In this chapter we discuss previous work closely related to our research.

As pointed out by Robert Beichner, " We need to change classrooms so that students dont have to just sit passively, but can actively participate in their learning. " [6]. Bonwell et al. discussed the benefits of incorporating active learning in classrooms [1]. They presented various barriers associated with active learning and recommended use of techniques such as discussions, short ungraded exercise and modified lectures. Benefits of Active learning in classroom range from deeper understanding of course content, constant feedback to and from students, development of variety of teaching styles, positive attitude towards learning and interaction in classroom [7, 8].

Many studies have been performed to explore the potential of mobile devices in active learning in classrooms. One such technique is use of clickers. Clickers have been implemented as specialized hardware [9], web applications [10, 11], and mobile applications [12]. Benefits of using clickers range from breaking the lecture flow to allow attention span recovery, increasing attendance, testing short term topic comprehension, and increased concentration and engagement to enhanced interaction between instructor and students [9]. Different implementations of clickers offer various functionality, like responding via SMS, Call, and novel question types: multiple choice, true false statements, etc. [13].

Student presentations have been found an effective active learning measure. "Learning by teaching" and "learning by doing" have been found to be constructive methods for learning and are exemplified by student presentations [14, 15, 16]. Apart from

development of content knowledge, Benefits of student presentations also include development of soft skills such as presentation skills, team work and collaboration [17, 18].

After MOOCs were unable to reach their potential, Armando Fox eliminated common myths associated with MOOCs and conceptualized inclusion of MOOCs into traditional classrooms [5]. His model takes MOOC features such as high-quality material, auto graders to refurbish the traditional classrooms to leverage the course and combat the issues of high attrition rate and lack of motivation. Many different studies have been conducted to convert a MOOC into SPOC [19] and vice-versa [20]. SPOC, in our study is casted as a hybrid model. Students engage with SPOC material in class as videos covering advanced topics shown in class, and outside the class in the form of videos assigned as homework for building the foundation of advanced topics covered in future lectures.

Bruff et al. have carried out work similar to ours by integrating an existing MOOC into the university course [21]. They leveraged a MOOC course and platform for lecturing, grading and discussion. There was a graded requirement imposed on students to complete the course. They reported the positive student engagement with course but also misalignment between online and face-to-face components.

3

Course Design

In our work, we blended active learning techniques with SPOC and offered a university course titled "Programming Cloud Services for Mobile applications" at IIIT Delhi, India in Winter 2015. A pre-study survey conducted at beginning of the course questioned enrolled students about their preferred sources for course material, past experiences with MOOCs, and preferred mode of lecture delivery. Out of 33 students who enrolled in the course, only 30 students responded to the survey. We asked them about their preference for web, videos and books as course material. We refer to books as the hard bound physical copies, web as the textual content available on World Wide Web excluding the video content. Among the three, web emerged as the primary choice for source of study materials. Videos closely followed web as second choice. When enquired about their past experiences with MOOCs, 66.7% reported enrolling in MOOC courses but with a low course completion rate of only 3%. 73.3% students preferred traditional classroom based teaching interspersed with videos as supplements. Encouraging results from the survey motivated us to design the course by blending a modified SPOC and active learning techniques. In the modified SPOC used in our study, the assignments and quizzes were designed by the instructor and there was no online version of the course for students to complete, which is customary for SPOCs described by Fox [5].

The designed course was 600 level, 16 weeks long, and was offered for the first time in the university. Prerequisites for the course consisted of knowledge of Operating Systems, Computer Networks and Mobile Computing. The enrolled student set comprised of 23 undergraduates, 9 masters and 1 PhD students. Students were provided with mobile phones having Android OS version 4.4 and above. They were well acquainted

with various pedagogies such as e-learning, MOOCs, flipped classroom models through prior courses. We now describe the various course components in detail as follows:

3.1 SPOC based Course Components

After designing the curriculum, we foraged for online resources. We found publicly available video playlists of Douglas Schmidt[1] and Jules White[2] which closely followed the designed curriculum. Relevant videos from playlists were used. Other resources were also referred to cover few topics in detail. Because the course was heavily programming oriented, we also presented code demonstrations in class. A few lectures included showing videos in class to introduce basic concepts. Advanced topics related to videos were discussed in class, thereafter. The students were also asked to enroll in an internal SPOC platform, IIIT-Delhi instance of Edcast[3] based on Edx platform, which was used to disseminate study material, auto-graded quizzes, and provided discussion forum.

3.2 Online Quizzes

As a part of offline assignments, the students were asked to watch the videos not covered in lectures and quizzes were released on Edcast. The videos available on popular MOOCs such as Coursera have simple multiple choice questions embedded in them. However, Edcast does not offer similar functionality. We replicated the similar behavior by asking the students to watch the videos and attempt the quizzes. Initially, quizzes were ungraded. Our aim was to analyze students' offline engagement with videos in unsupervised setting but, because of lack of participation and enthusiasm, quizzes were later made part of students' grades. Multiple videos covering a topic were grouped together in a single quiz. A total of 6 quizzes were conducted, out of which best 4 made into the final grade.

[1] `https://www.youtube.com/channel/UCt-Wvc_ojTzGLpjhruIXYSw/playlists`
[2] `https://www.youtube.com/user/juleswhiteart/playlists`
[3] `https://iiitd.edcastcloud.com/`

3.3 Clicker App

To encourage active learning, we developed a clicker app for mobile devices. Students were asked to bring their phones in class. A pilot study was conducted in a prior course offered in Monsoon 2014 to introduce students to web based clicker app, Socrative[1]. Objective of the study was to gauge the effectiveness of actively incorporating mobile devices in classroom to encourage learning. We prepared multiple choice questions based on the lectures in advance. During the lecture, students were asked to respond by choosing an appropriate option. While students benefited from the app, time consumed by one iteration of app averaged 6 minutes which limited its use in regular lectures. Hence, for the current study, a simple clicker app was implemented on mobile device and time consumed by single iteration of app was reduced to 1 minute. The mobile app emulated the web version, was built on Android platform and connected to web server over campus Wi-Fi network. The aggregated responses were available in the form of graph via a web app. The main motivation for using clicker app was to engage students during the lecture, quickly gauge their understanding of concepts and respond with corrective feedback. Thus, we did not establish any association between students' identity and responses. Typically, the app was used at least twice during a 90 minutes lecture.

3.4 Students' Presentations

We consider student presentations an effective technique for collaboration and peer assisted learning. To encourage collaboration among students, instead of writing mid term exams, they were divided in a group of 5-6 members and were assigned a set of 5 videos from the SPOC. They were asked to prepare presentations and code demonstrations based on the concepts presented in the videos. To enhance the audience engagement, the presenters were advised to use clicker app during their presentations. Presentations carried a weight of 10%.

Later in the course, students worked in teams to develop projects based on cloud and mobile services, based on the concepts covered in course. Students also wrote

[1] `http://socrative.com/`

an exam based on the pattern of online quizzes. The exam was conducted in similar fashion as end semester exam and carried a weight of 15%.

4

Data Collection and Results

To analyze the impact of blended model on students' learning, students were asked to participate in various non-mandatory surveys after the conclusion of individual activities.Overall, the hybrid course structure was successful in meeting the course objectives and students' goals.

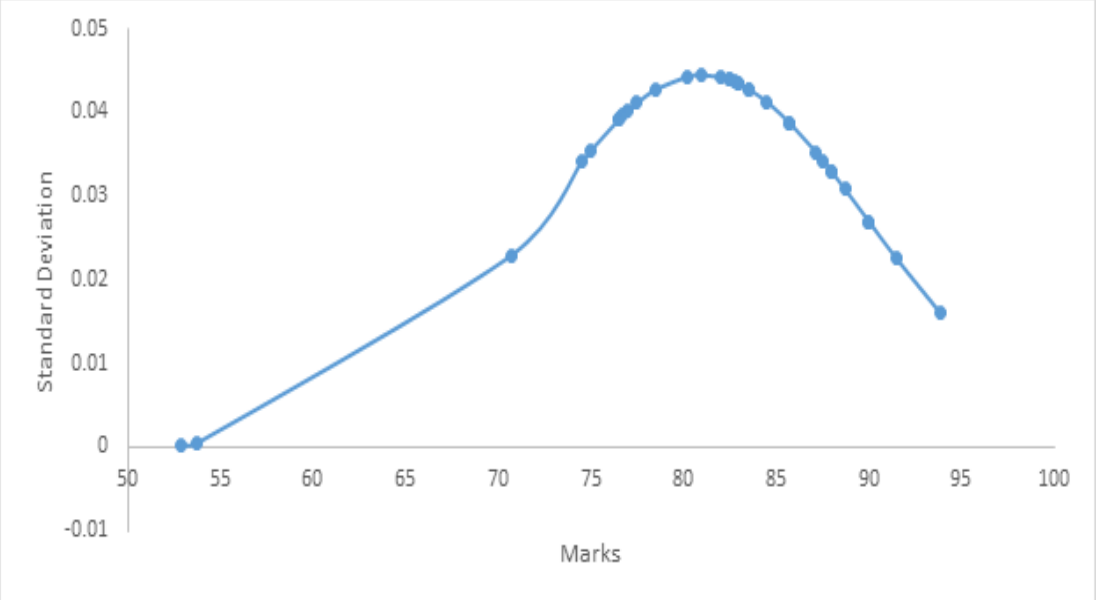

Figure 4.1: Distribution of marks scored by students in the course

Figure 4.1 shows the distribution of marks scored by students in the course. 84.8% students scored more than 75% marks. In our final survey, 30 students participated and reported high level of goal achievement. The results are enumerated in Table

Table 4.1: Goal achievement as reported by 30 students after the course

Course Objectives	Student Satisfaction Average (On scale of 5)
Understanding Cloud based systems' architecture, protocols	3.96
Understanding HTTP and Rest, Ability to create REST Services	4.05
Understanding of web technologies like JSON, OAUTH, NoSQL Databases etc.	4.14
Ability to build complete end-to-end high performance Cloud+Mobile systems	3.83

4.1. Students found lectures to be well organized and well taught, and rated short exercises, demonstrations, clicker app effective for their continued engagement and interest in lectures. They showed similar performance in both SPOC and Non-SPOC based questions as evident from Figure 4.2.

Figure 4.3 compares marks scored by students in practical and theory components of the course. Programming assignments, presentation and project are parts of practical component, whereas, online quizzes and final exam contributed to the theory component. As the course was heavily programming oriented, our focus was on providing students with hands-on experience to gain in-depth understanding of the course. This shows that our course design was successful in imparting practical knowledge to students.

Thus, the hybrid model was successful in incorporating SPOC in the classroom. Students' learning was not significantly impacted by a single mode of instruction but was a result of tight coupling between the two. However, we found a considerable difference in students' performance in last exam compared to online quizzes, even though the exam was conducted in a pattern similar to online quizzes, as shown in Figure 4.4.

We attribute this drop to various factors such as: 1) constraints on referring external sources during the exam, 2) prior information about 85% marks scored out of 100% hence lacking motivation to spend necessary effort, and 3) negative marking of wrong answers.

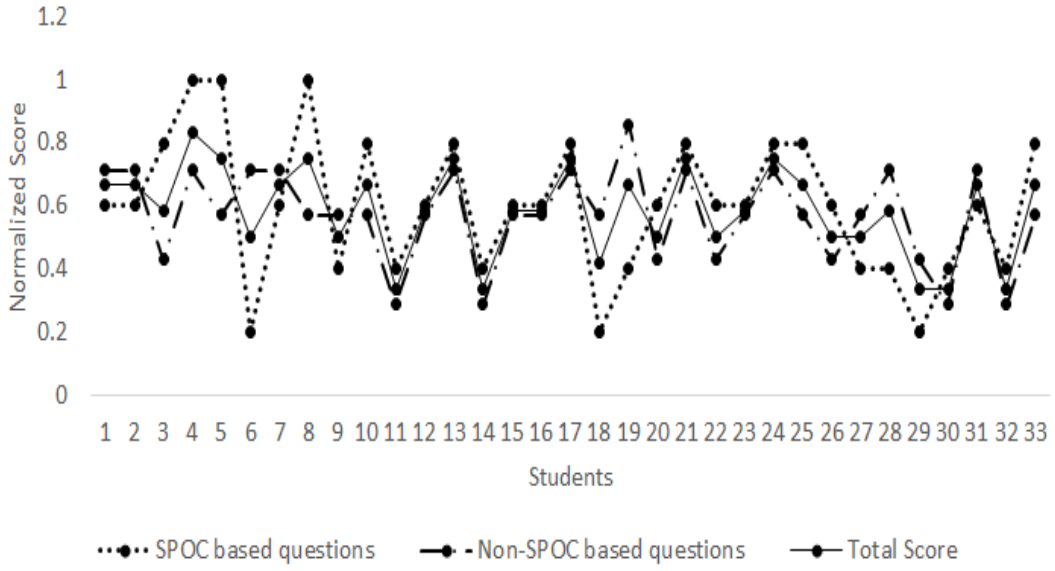

Figure 4.2: Comparison of students' performance in SPOC based and Non-SPOC based questions in final exam

We now present our findings for individual course component based on results of surveys or marks obtained by students.

4.1 Online Quizzes

Figure 4.5 shows students' participation in online quizzes based on videos. Quizzes 1, 4, 5 and 6 have the highest number of correct answers. Quiz 2 was attempted by minimum number of students. We attribute this trend to lack of student motivation towards ungraded components of the course. When the quizzes were converted to graded component of the course, we observe an increase in number of students correctly attempting the quizzes.

4.2 Clicker App

Use of clicker app in class was geared to engage students actively in classroom. 26 students responded to the survey. Out of 26 students, while 25 students found the instant feedback from instructor helpful, 1 student also commented:

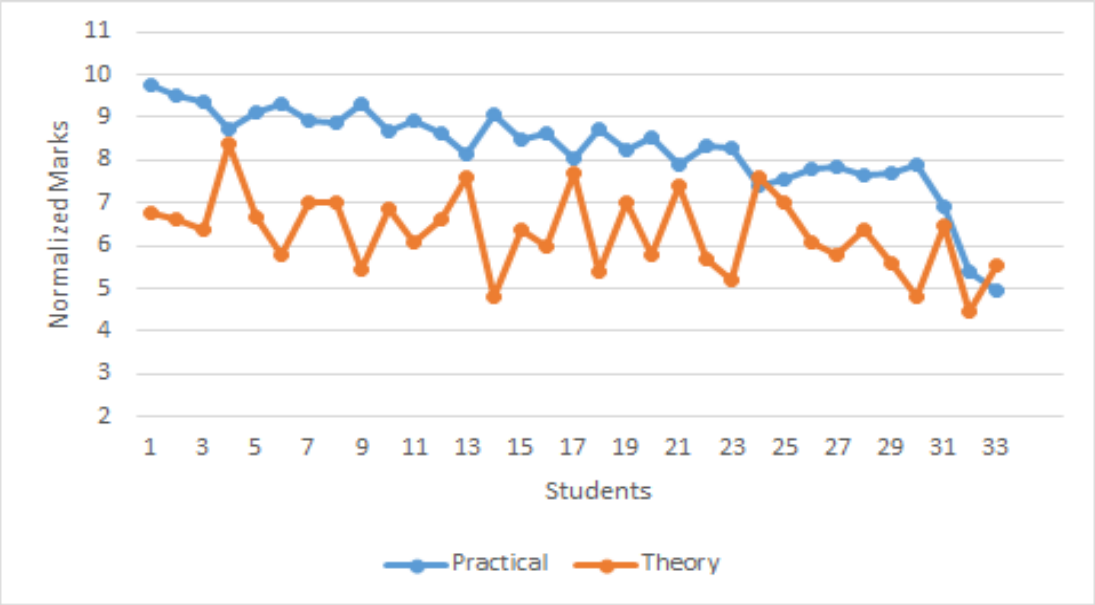

Figure 4.3: Comparison of students' performance in practical and theory components of the course

> "Its more for instructor's feedback. Found 2 ways to use this as an instructor: 1. Use in starting of topic to know current understanding of students about it and prepare/teach accordingly and 2. After the topic is taught to know did students understand it well enough."[sic]

The results show multiple benefits such as improved engagement in lectures, better concentration in class, instant doubt clarification. However, the students reported no impact of app on their decision to attend the lectures. Also, as the course progressed, the instructor noted a decline in the use of clicker app in lectures. The observation is supported by 30% of the students who either used the app for particular questions or used the app regularly in the beginning of the course but not towards the end. We attribute this decline in use of clicker app to reduction in its novelty and student enthusiasm as the course progressed. 84.6% students are willing to use the app for other courses but would like to maintain the anonymity while using the app.

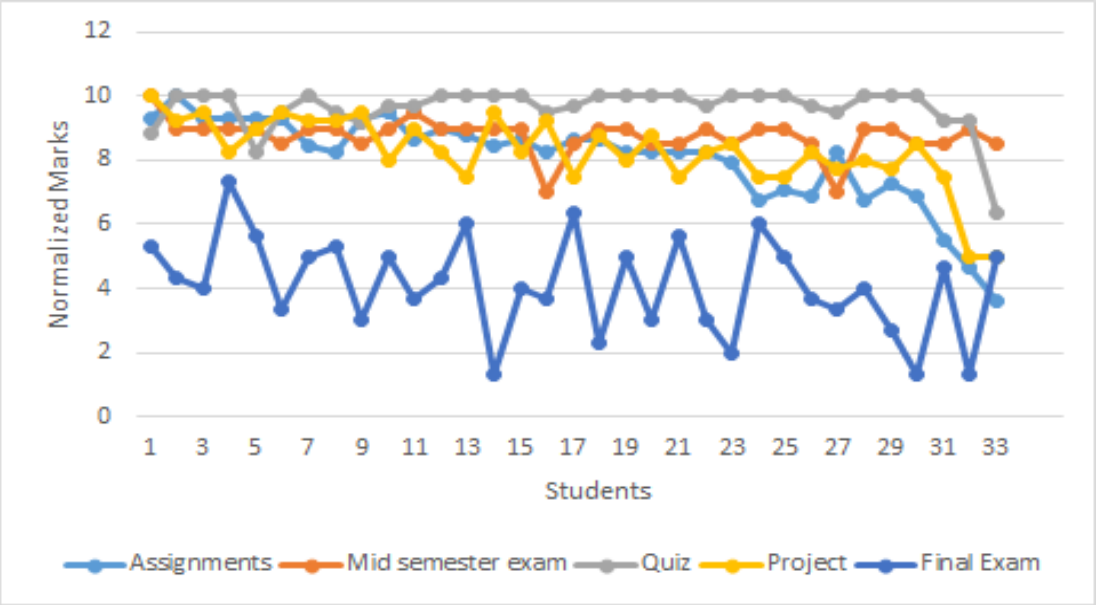

Figure 4.4: Comparison of students' performance in individual course component

4.3 Students' Presentations

The students were surveyed from the perspectives of presenters and audience. 30 students submitted responses to the survey. 66.7% students reported using videos as a guide and referred to other sources such as web, for preparing the presentation and code demonstrations. Through this activity, we also stressed on students' soft skills: teamwork, collaboration and presentation, which are considered to be very important in academia and professional domains alike. Presenters reported high levels of collaboration and team work in the groups. With the understanding level of nearly 75% achieved during the presentations, satisfactory doubt resolution and interaction among students, presentations emulated a general lecture delivered by instructors quite well. They were also reported to be a suitable replacement of exams. However, students as both presenters and audience felt a strong need of instructor's presence in classroom to address doubts and questions even though the presentations were student driven. We believe instructor's presence acts as a strong motivator for students. Hence, the course structure is more suitable for learning as compared to SPOCs because of self motivation required by them.

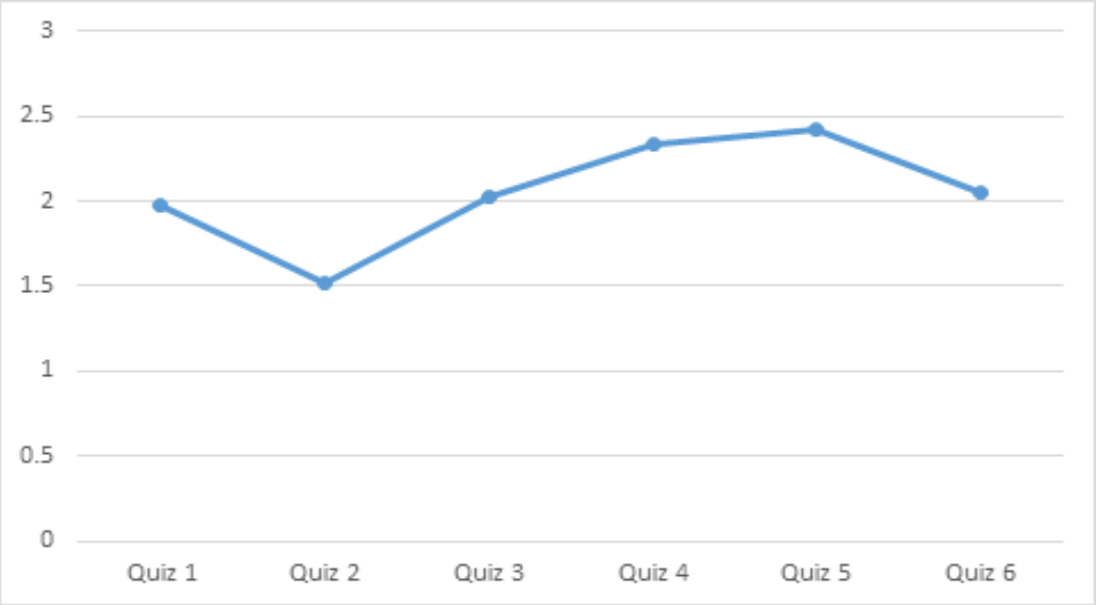

Figure 4.5: Trend of quiz attempts

4.4 Use of Edcast

We found a strong dependence on peer groups for clarification of doubts among students. Out of 26 students, while 6 students admitted to never approaching instructor for doubts clarification, 16 students reported approaching instructor only when the peers were unable to resolve the doubts satisfactorily. We observed, students rely more on face-to-face doubt clarification than using Edcast. Thus, Edcast failed to foster student discussions outside the classroom.

5

Discussion

For successful learning outcomes in any course, instead of viewing one another as alternatives, strong partnership between different learning pedagogies has to be established, which can be further enhanced by use of technology. Technology allows the instructor to offer comprehensive, updated courses, learning opportunities and better time management. This makes provision for students to keep stride with the advancements taking place in other parts of the world. The instructor is better able to lend a guiding hand to students for learning by directing the knowledge transfer from different sources. The uninitiated instructors should be encouraged to learn and familiarize themselves with the emerging pedagogies to maximise the gain.

Typically, MOOCs do not enforce any prerequisite courses on the students. To maximize the learning from MOOCs, it is important to have a strong foundation in prerequisites of the course. The objective could be met under the guidance of instructor. Supervised incorporation of MOOCs in curriculum can allow for more sophisticated, advanced and up to date courses being offered.

6

Limitations

Learning is subjective experience for every student. We relied on surveys to account for the subjectivity and study the students' experience and face the problem of missing data. Because the surveys were not mandatory, dissimilar number of students participated in each survey. In a relatively small data set, every opinion holds considerable weight and can drastically skew the results. Hence, small number of students and their lack of participation may have caused us to miss some anomalous or hidden behavior. To overcome it, we suggest conducting the study on a larger group of students. This will make surveys less susceptible to skewed responses.

We do not have any statistics on students' experience with SPOC platform, Edcast, and have to rely on students' feedback and surveys. Even though our results are similar to those reported by other researchers, there is a distinct lack of quantitative analysis in our study. Access to detailed students' Edcast footprint will be vital in developing a detailed student profile.

7

Future Work

The focus of this paper has been on designing a hybrid SPOC course and incorporate technology into it. The MOOC component remains largely unchanged and other components are fitted around it. For a successful collaboration, MOOCs have to be accommodating with other components. This raises certain questions: Can current MOOCs be made to adjust around existing traditional components? How can MOOCs evolve to leverage the technology in traditional classrooms? The wide offering of MOOCs provide ample opportunities to instructors for incorporating custom components into the existing courses and collaborate with other instructors.

The current technology incorporated in the course has wide scope of improvement. Design of clickers currently allows only a single channel of communication, initiated by the instructor. Introduction of different aspects to clicker, thereby allowing students to initiate the communication provides a wide area of research.

Anonymous responses elicits more honest responses compared to non-anonymous ones. Anonymous communication channels can be established in class to make reticent students actively participate in activities. Encouraging students to actively initiate communication with instructors and focusing on shy students to improve individual learning goals offers wide area of research.

8

Conclusion

In conclusion, our experience with hybrid blended course was very successful. The results show successful integration of online resources in the course. Students were enthusiastic about trying new learning techniques and appreciated the hands-on, practical learning environment provided to them. However, prime motivation for students is still centred around their grades and it determined the efforts put into the course by them. Students were willing to make efforts only if it translated into targeted grades, as shown by trend of online quizzes attempted by students. Revealing marks to students before last exam translated directly to decline in their performance because it had little impact on their final grades. Also, students' interaction with technology was governed by novelty attached to it. New technologies failed to hold students' attention for an extended period of time, as reported by decline observed in use of clicker app in classroom. Even though students recognized the benefits of these technologies and were reported to be willing to use them in other courses, decline in active use of technology painted quite a different picture. Thus, an instructor needs to establish a balance between grades and learning activities to ensure continued students' inputs till the very end. Incorporating classroom activities in grades may hold students' interest longer and lead to better utilization of technology.

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