A Flipped Classroom Approach to Teaching Engineering C Programming

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Abstract— Flipped classrooms reverse the role of traditional teaching where in students gain exposure through learning material like videos, power point presentations and notes outside classroom and the class time is utilised for problem solving and discussions in order to master the concepts. Flipped classrooms encourage students to learn at their own pace releasing frustrations and undue burden on students to pace up. Those students who have to miss some classes do not lose the course content. It provides opportunity for active interactions among students outside class via an online course website, facilitates social learning and is successful in providing timely, accurate feedback required by instructor to keep track of class progress and render required help to students. The intellectually drilled-down personalised feedback reports of tests helps in identification of the weaker areas or concepts misunderstood during the course of learning. The timely help to combat weaker areas accelerates the pace of learning and is not possible in traditional learning with large students in a classroom. Individual student difficulties are easily traced by the teacher using Outcome Based Education (OBE) reports generated by online OBE softwares.

The online course 'Programming in C' taught using flipped classroom platform Inpods registers the students and divides them into pod groups for group assignments. Short videos of 15 minutes each containing one topic of a chapter were developed to maintain attention level in students, keeping the mind the short attention span of 21st millennia students. The created assignments were meticulously designed to test students on their level of understanding concepts. Timely accurate personalised reports paved an easier way for re-teaching .The student feedbacks aided in improving the course delivery material . Difficulties of the students in programming were handled efficiently by knowing weak-spots well on time and learning pace of C programming in students clearly enhanced using flipped classrooms.

Keywords Flipped classroom, Outcome Based Education(OBE), Feedback, Learning, Teaching, programming, re-teaching

INTRODUCTION

Flipped Classroom is a blended instructional strategy in which the instructional content is delivered to students at home in the form of online videos, presentations via a software portal named as Virtual classroom wherein all students are enrolled and instructor presents material and the class time is utilised for problem solving and doubt clearing of students.

Flipped Classroom is a newer and well –known established strategy. Woodland Park High School chemistry teachers Jonathan Bergmann and Aaron Sams are considered as driving forces in flipped teaching at the high school level. In 2007, they recorded their lectures and posted them online in order to accommodate students who missed their classes[1]. In 2011 educators in Michigan's Clintondale High School flipped every classroom After 20 weeks, students in the flipped classroom were outperforming students in the traditional classrooms. Further, no students in the flipped classrooms scored lower than a C+. [1]The upcoming of Khan Academy brought flipped classroom into limelight.[2]

The flipped classroom encompasses some approaches, including active and collaborative learning, problem-based learning and project-based learning [3].Flipped classrooms give students a chance to learn at their own pace and time. The students can watch online videos distraction free and open up new discussion on doubtful topic leading to active discussions amongst peers.

A flipped classroom approach to teaching engineering C Programming course taught in the 1st year , first semester of a typical undergraduate engineering education is explained. When a programming C course was earlier taught to students, it was observed that they focus more on copying content rather than understanding the fundamental concepts. Eventually, the weak foundations in programming continued next year to C++ and also hampered their coding skills in third year for Java and fourth year in Advanced Java. To combat this weak progress in C programming, the flipped classroom was created using Inpods as a platform for data.

METHODOLOGY

While working on Project GENTLE (**G**lobal **E**ducation **N**etwork for **T**eaching and **L**earning **E**ngineering) in collaboration with IUCEE and inpods , online videos of 15 minutes each were made for each concept in a chapter. The videos were made of shorter duration because the attention span of 21st millennia students is very limited and to make them focus for more than 10 minutes continuously is a challenge. Pertaining to created videos, 2 MCQs of 10 questions each and a few descriptive, long answer assignments were developed to test the grasp of student on that concept taught via video. The MCQs were automatically evaluated after students attempts and scores are displayed to him, along with correct answers .While working with descriptive assignments, the instructors checks the answers manually and scores are uploaded on student portal. The information panel was used to convey important information to students such as quiz time, syllabus.

The students were enrolled in Inpods using their email ids and divided into small pod groups for doing project discussion or group discussions. After the enrolments, students were asked to come prepared by listening and watching videos from home before each lecture. The students were tracked as to videos were watched or not by inpods software available to instructor. The assignments were solved by the students in class and doubts were discussed.

The active discussions were monitored by the instructor and relevant answers were provided for their doubts to keep the motivation level high.The topics in which majority of class had scored less marks in online tests was re-taught and a re-exam was prepared to retest their understanding of the concerned topic.
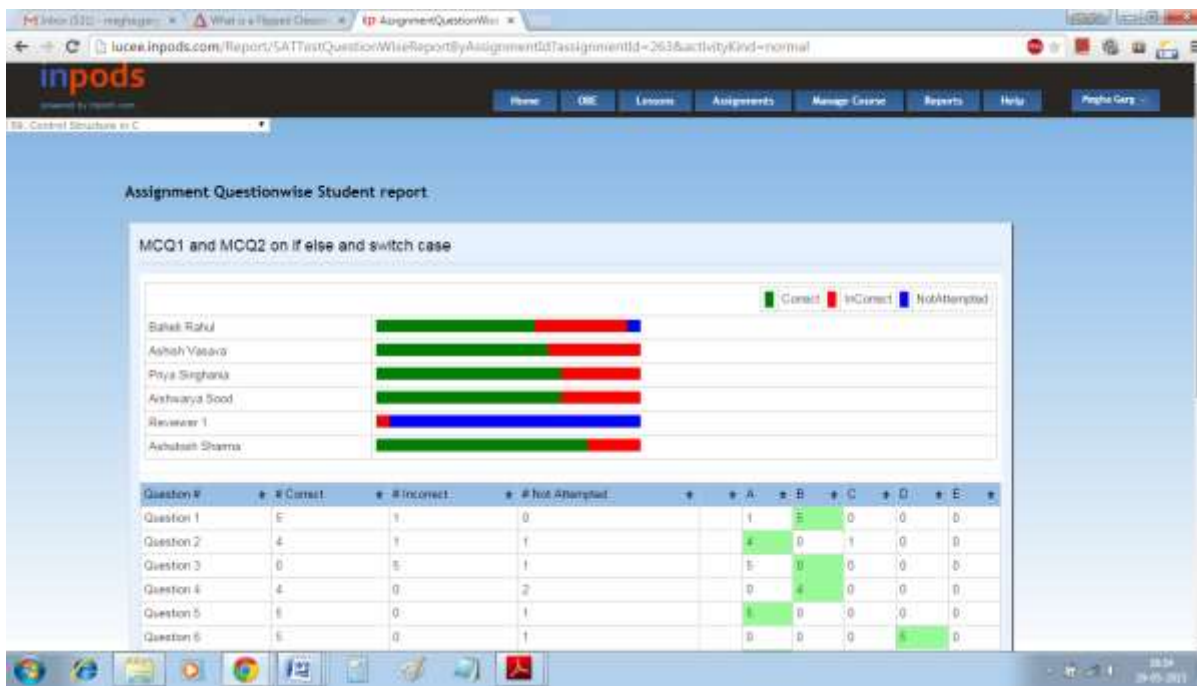
RESULTS

The flipped classroom approach was liked by the students as well as the instructor. It proved out to be successful in increasing the confidence and improving coding skills better as compared to the previous batch that solely learnt through traditional classroom approach. It was found that students who regularly watched lessons and solved MCQs scored far better than students who just relied on classroom delivery. Since the assignments had a deadline, the students became more professional and false excuses were not able to delay assignment submission.

Individual tracking of participation and personalised reports [Fig1] provided by Inpods paved a way to drill down progress of students individually and collectively. It made it a lot easier to identify the misconceptions among students of a particular topic because most of students attempted its MCQs wrong. The instructor got to know at a early stage where re-teaching was required. And re-teaching helped the students understand difficult concepts easily.

This technique proved advantageous mostly to average students who could re-watch the videos again till they could absorb the information presented. Also, the students could see each others answers via discussions and learn by it without any hesitation.

The various group discussions and survey proved advantageous as they inculcated a sense of social participation among students as well as helped the instructor to re-design the course and customise it as per needs of students .This will add as an asset to the forthcoming semester students.

Fig 1: Assignment Report of Students on If-else and Switch Case.

The result of this batch had higher grades as compared to a batch taught with tradition classroom. The students learnt coding skills better, had greater interest to learn programming and understanding fundamentals of programming, making it easier to cope up with future requirements of coding in course taught during higher undergraduate years.

The work done for development of this online flipped classroom course proved inspiring and the university will now be hosting 6 new online flipped courses in the upcoming semester for each branch of engineering.

CHALLENGES

Although flipped classrooms had many advantages, the conduction had its own challenges. The creation of online videos and assignments was very time-consuming and an additional to manual notes preparation done for other batch taught via traditional classroom approach. Sometimes the students had internet accessibility issues, so the concepts had to be taught in classroom ignoring the available online content. A few students had to be motivated a lot to keep watching and working as flipped classroom relies on student a lot. There was no mechanism to test the home-works given were done individually without cheating.

CONCLUSION

Flipped Classroom are an innovative pedagogical tool that are an aid to teaching and provide outcome based education, easily tracked by continuous student assessment reports. The online environment eases the social interaction amongst students. The weak spots of students are identified and worked well on time.

RECOMMENDATION

The use of flipped classroom online course in Programming in C using Inpods went successful, was cost-effective, with least technological requirements and is recommended for use by universities having adequate internet access. The flipped course was successful in clearing basic concepts, keeping students motivated and self-driven during course. Also, the course feedback helps in improving the quality of instructional material and students learn better at their own pace.

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