Collaborative Learning among Heterogeneous Groups in Virtual Mode in Higher Degree Program

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1. Abstract

This case study explains the implementation of collaborative learning among heterogeneous student groups, in a course offered in virtual mode. The course in context is “Internetworking Technologies”, an advanced course in computer networking, offered to students who are enrolled for a higher degree program of an Indian technology and science university. The students are engineering degree holders, most of whom are employed in various organizations located in India and abroad, and their varied educational and professional backgrounds and skillsets rendered a certain amount of heterogeneity to the class. The objective of the case was to implement experiential learning and achieve higher levels of interaction and knowledge sharing among such students/student groups.

The case details the design of experiential learning component for the course, development of exercises, planning and execution of the evaluation component among student groups, evaluation of student performance, and assessment of their learning experience through feedback collection. The study reveals that collaborative learning can be achieved in virtual mode, and provides evidences of high levels of student engagement among geographically dispersed student groups.

2. Purpose of Research

In the conventional classroom teaching model, experiential learning is obtained through lab experiments and simulation exercises via face-to-face interaction, where the students have the opportunity to interact directly with their peers and teachers. One important pedagogical aspect that is commonly implemented in a traditional classroom model is group activities, which encourages knowledge sharing among students and very often increases the synergy in classrooms.

However, in the virtual mode of learning, the absence of face-to-face contact sessions poses several challenges to the teaching-learning pedagogy, including difficulties in rolling out group activities. In some cases, these are accentuated by the eclectic nature of educational and professional backgrounds of students. The purpose of this research was to evaluate the feasibility of a collaborative approach to offering experiential learning to students from diverse backgrounds in a virtual classroom.

The approach described in this case is not limited to a certain course or offering. With appropriate planning and student orientation, this approach can be replicated in other courses also, in a virtual classroom.

3. Methodology

The research is based on a study conducted for "Internetworking Technologies", a course offered by BITS-Pilani in Computer Science and Information Systems, as part of their Work Integrated Learning Programmes. The course had 130 students enrolled, and was delivered spanning over a 4 month period (one semester). The methodology included: (i) design of experiential learning component (ii) formation of student groups (iii) usage of simulation tools for experiential learning (iv) student group work (v) assessments via presentations and demonstrations (vi) assessment of student learning experience through feedback collection.

4. Topics Covered

The rest of the paper is organized as follows.

i. The section on course delivery model explains the framework of delivery of this course and it's characteristics as applicable to the class in context.
ii. This is followed by a section on the design of experiential learning component for this course.
iii. The next section on formation of student groups explains the reasons behind implementing collaborative learning in this case.
iv. This is followed by details on assessment of experiential learning component via presentations and demonstrations and the evaluation methodology
v. The paper concludes with observations on the student engagement and the assessment of student learning experience through feedback collection

5. Description of Activities and Major Results

a. Course Delivery Model

BITS-Pilani has been using technology to deliver courses in virtual mode for the last many years. This course in context was also delivered in virtual mode. There are various

requirements that would make online classroom sessions effective, such as facilitating audio-visual communication, facility for student-instructor interaction through audio-visual means, text messages and chat lines, whiteboards, and other interactive features such as raising one's hand before contributing to the class or voting [1].

However, in a geographically dispersed student population, collaboration among students outside the classroom is less in many cases. Today, social networking serves as a catalyst for developing new learning models which emerge out of an organic mix of "wisdom of the crowds" and "just in time" social learning [2]. In traditional classroom teaching, interactivity is a major focus in the design of mediated instructional settings [3]. Interactivity also plays a crucial role in the development of cognitive skills. Given these, to maximize learning outcomes, it was important to extend the collaborative nature of traditional classrooms to virtual classrooms. Therefore, the experiential learning component for this course was designed keeping these considerations in mind.

b. Design of Experiential Learning Component

The cognitive domain in Bloom's taxonomy involves exhibiting memory of learned materials through application, analysis, synthesis and evaluation. Moore [7] has identified three interactive relationships associated with distance learning: learner–content, learner–instructor, and learner–learner interactions.

The goals of the experiential learning component in this case was to focus on the synthesis aspect of Bloom's taxonomy, and to enhance learner-learner interactions.

The students enrolled or this course were from different educational and professional backgrounds. Most of them possessed a B.E./B.Tech. degree in Computer Science/ECE/EEE or equivalent. The professional skillsets were vastly different – software or hardware design/development/test, product management, customer support, and so on, with work experiences ranging from around 2 years to around 14 years. This increased the heterogeneity in the classroom.

The use of simulators is very common in courses related to computer networks, in universities, since there may not be physical hardware available for all students to experiment with. During classroom sessions, some of these simulators were demonstrated to the students to provide guided learning, and they were encouraged to experiment with the simulators outside the class hours, for better internalization of concepts. Following this, as a mini-capstone project/assignment, a set of 12 different problems, varying in nature and complexity, were published to the students.

BITS-Pilani conducts each course with 3 major evaluation components – a mid-semester exam, conducted around the middle of the semester, a comprehensive (final) exam, conducted at the end of the semester, and an experiential learning component. The mini-capstone project/assignment was rolled out at an appropriate timeframe between the two exams, in such a way that by then, the students had sufficient application and analytical knowledge, and were ready to work at the synthesis level.

c. Formation of Student Groups

In the context of e-learning, it is important to create a social space that enhances student learning [4], and a large part of our learning experience comes not just from what we learned, but also how we learned it. S, James in "The Wisdom of Crowds" [8], identifies four conditions that characterize wise crowds: (a) diversity of opinions (b) independence of opinion (c) decentralisation of experience (d) suitable mechanisms of aggregation. The presence of these conditions in the virtual classroom, triggered the creation of student groups in order to create a social space that could enhance student learning experience. Thus, the set of 130 students enrolled for this course were divided into 22 groups - 20 groups of 6 members and 2 groups of 5 members each. Each group was instructed to discuss among their team members, choose a single problem (from the set of published problems) that would be beneficial to most of them, and work on that towards the mini-capstone project/assignment.

The Moodle-based platform [5] used for delivering this course provided support for group based activities such as:

- Creation of group discussion forums: The platform supported general discussion forums in which any student enrolled for this course could

participate. It also provided group discussion forums which were configured such that students could view the discussion threads of all groups, but could contribute only to the threads that belonged to their own group. A lot of discussions and sharing of information among the groups took place on these forums.

- Assignment submissions: The platform allows submission of individual assignments. Since this was designed for collaborative learning, the platform was set up to accept a single submission per student group.

d. Assessments via Presentations and Demonstrations

There were 2 parts to each project:

- Report submission
- Presentation/Demo

Report Submission

- Each problem description was tagged with the corresponding set of artefacts/submissions [presentation slides, source code, simulation configurations, README files etc.] expected from it.
- One submission per team - Each team had to submit artefacts as mentioned in the problem they chose, by uploading the same to the Moodle based platform on which the course was run.

Presentation/Demonstration

- Each student group was required to make a presentation of 30 min duration, on their assignment at a scheduled day and time.
- Each team's presentation was planned to include:
    - A brief technical presentation (10 min) of the assignment topic
    - Demo of the simulation/application (10 min)
    - Q&A session (10 min)

e. Evaluation Methodology

The assignment evaluation was done on the basis of the following criteria:

- Quality of submission artefacts

- Presentation
- Quality of demo
- Q&A

f. Student Engagement - Observations

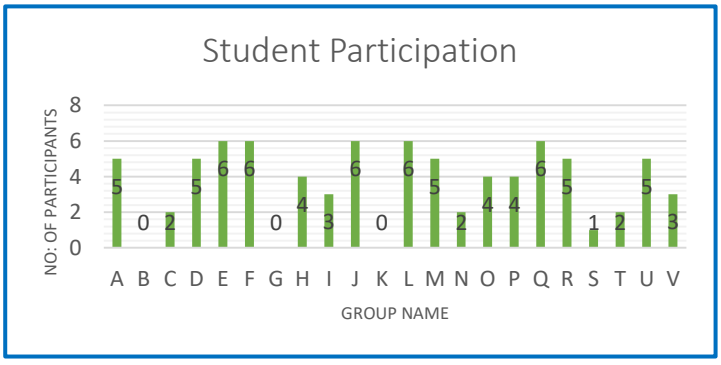
It was noticed that there was a lot of initial activity in the group discussion forums to locate group members. The forums also served as a platform for the student groups to break the ice, which was important given that the classrooms were virtual, and that they required a great deal of collaboration among themselves to meet the requirements of the project and make team presentations.

Some groups divided the work among themselves, with each of them taking up portions of the project, and put together a systematic plan for periodic sync-ups and knowledge sharing. The outcome of this collaborative learning was best for such high-synergy student groups.

In some cases, a clear leader of the group emerged, who then worked with the rest of the group members to plan and execute their group's demo/presentation.

It was also observed that though this exercise was designed primarily to enhance learner–learner interaction, the learner–instructor interaction was also enhanced in the process, as an offshoot of the group tasks. Some students, individually or for their groups, requested for sessions with the instructor to clarify questions related to their task at hand.

- The chart shows the no: of students per group who participated in the presentations.



- There were representations from 19 groups (out of 22 groups).

- A total of 80 students (out of 130 students) were present during their respective presentation slot.

g. Assessment of Student Learning Experience through Feedback Collection

There were concerns from some students initially on the following aspects:

- Inability to locate team members
- Requests for change of assignment topics/presentation slots
- Assignment taking up too much of students' time

However, at the end of the course, student feedback indicated that though the assignment took a significant amount of time, it virtually forced them to learn the subject and was worth the effort.

It was also noted that most students were enthusiastic about getting a chance to present their work and share their learnings with others. Some presentations were attended by members from other groups also. However, as in all cases, there was a section (though very small) of students who found it difficult to invest the required amount of time and effort needed for the assignment.

6. Implications and Conclusions

In this study we identify key steps for successful implementation of collaborative learning in heterogeneous groups over virtual mode, in the context of an online course delivered by BITS-Pilani. It was observed that the collaborative learning did indeed increase the student engagement and enhance their learning experience. Knowledge sharing and active discussions to meet a common goal increased the virtual classroom interaction both at a learner-learner level and learner-instructor level. The discussions among the student groups also enabled better internalization of the concepts taught in class, as was evident during the Q&A session of the group presentations. A future direction that this experiment shall take is formation of student groups by applying appropriate criteria to identify the kinds of students who should be in the same group

to maximize the group project's learning effectiveness, and designing experiential learning component best suited for individual student groups.

7. Key References

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