Probing Students' Affective Domain in an ICT-enriched Course

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The incorporation of information and communication technology (ICT) has become common in university courses. The benefits of using ICT in the classroom are well established from several studies. While there are sufficient data on the development of students' cognitive abilities, there are only few studies on the development of affective domain of students through the use of ICT. In this study we have attempted to determine the components of students' affective domain developed in an ICT-enriched course. The course is a post-graduate engineering course that makes use of ICTs such as Video on Demand and Moodle in a learner-centric mode. In this study we use qualitative as well as quantitative data to determine students' notions about the multifaceted use of ICTs in a regular classroom.

Keywords: ICT, Affective domain

Introduction and Previous Work

Information and communication technology (ICT) has become an integral part of education due to growth and development in the field of technology, and due to the globalization in education. The judicious use of ICT in education has not only minimized the barriers of the distance, place and time, but also made learning more effective (Sheard & Carbone, 2010). A multifaceted approach is required to integrate ICT in education. The process is complex as different aspects such as classroom environment, learning methodology, learner's involvement, instructors' competencies, and suitability and pedagogy of curriculum have to be carefully designed (Collis & Moonen, 2002). A blended teaching-learning approach is recommended for effective use of ICT in education: one that allows creation and utilization of ICT-enriched instructional strategies, along with use of a well defined pedagogy (Hoic-Bozic, Mornar, & Boticki, 2009).

For the overall growth of students, the development of all three domains: cognitive, psychomotor and affective, is a must. A greater part of the educational process however, focuses mainly on the development of cognitive and to some extent to psychomotor domain. The development of affective domain remains mostly unattended to (Adkins, 2004). Attributes like attitude, motivation, and internalization of values are some of the key factors which define affective learning. Students' interactions with each other and with faculty play a very important role in defining their emotions and feelings developed during the classroom interaction (Russell, 2004).

This study is conducted with the aim of defining the attributes of affective domain developed through an ICT-enriched course, and characterizing the relations between them. This paper is a part of a wider study on the multifaceted use of ICT in higher education. Various studies have been conducted to study the multifaceted use of ICTs and its effects on students' learning, motivation, and attitude toward the course. Studies on collaborative learning suggest that the use of media formats is effective in an online learning environment and helps in achieving higher levels of cognitive objectives. However, the use of multimedia is time consuming and requires competencies to use them. Hence its use may not be not well accepted (Juuti, Lavonen, Aksela, & Meisalo, 2009; Kakasevski, Mihajlov, Arsenovski, & Chungurski, 2008; Nagi & Suesawaluk, 2008). Studies on students' perception indicate a positive attitude towards the use of ICT in education, but students might prefer to learn in traditional classroom settings (Buzzetto-More, 2008; Goyal & Murthy, 2009; SPOT, 2001).

Technical platforms may support learning communities in different ways that include both cognitive and affective elements. They should provide the learning community with synchronous and asynchronous means of communication. This can be done by providing functions like email, newsgroups, chat, shared databases, concepts of group awareness, scheduling and mind mapping tools, shared whiteboards, document processing software and multi-user simulation and exploration environments (Magenheim, 2003).

As we can see from the results of the above studies, incorporating elements of ICT in the instructional strategy can present many challenges for an instructor. In order to achieve the learning goals in an ICT-enriched course, there has to be a match between learning objectives, content, pedagogy and competencies of students as well as the instructor (Allan, 2007).

Course Framework: Context of the Study

The course under this study was a postgraduate level course on digital controls. This course was recorded and transmitted live in the Autumn 2008 semester as well as in Autumn 2009. Though the course content and instructor remained the same, the methodology deployed to teach the course was different for the two semesters. The Autumn 2008 course was a traditional lecture-based course. In the autumn 2009 semester (focus of this study), a constructivist approach was used to systematically incorporate ICTs in the instructional strategy. The following three subsections describe details of the various components of the course and the ICT-enabled resources available for students.

Multimedia technology: Recorded courses

Multimedia technology was used to equip students with the lecture recordings of the Autumn 2008 semester course. Recordings of the classroom activities were streamed live through webcast. These lectures were later uploaded on the Intranet server. Students had access to the past and current semesters' recording at all times in the form of Video on Demand (VoD).

Classroom instructional strategy

A traditional classroom involves a lecture on new topics, explanation of difficult concepts and clarification of doubts. The instructional strategy in this course was substantially different. Students were expected to view the VoD lectures from the previous year's course, go through the slides available on intranet, and ask a question on the learning management system Moodle, on the relevant topic. At the beginning of each class, there was a 15 minute quiz based on the content of the lecture that students were expected to view. This was followed by an hour-long discussion, wherein the questions asked through Moodle and other spontaneous doubts were discussed. Students were explained this teaching-learning methodology at the beginning of the course, and again at appropriate times during the semester. They gained hands-on experience by running codes on the open-source simulation software Scilab (http://www.scilab.org). Activities like the course project, development of Wiki, and summative evaluation were clustered at particular times in the semester. The role of the teacher in this course was a combination of a facilitator and guide, ensuring the progress of the students in the correct direction. The instructional process is described in the schematic diagram in Fig. 1.

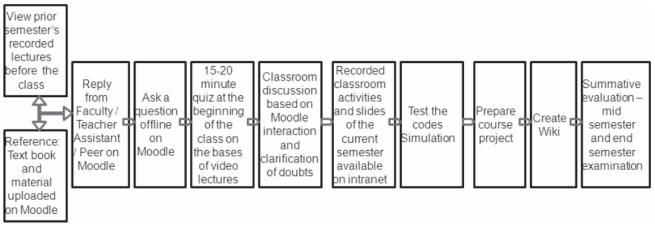

Figure 1: Instructional strategy followed in the course

Learning management system: Moodle

In this course, Moodle was used in a personalized manner. Each student could interact with the faculty member individually, as well through public forums. This encouraged students to promptly clarify their doubts. Moodle also allowed students to interact amongst themselves, and with teaching assistants. Different forums were created for assignments, quizzes, VoD, course project and general queries. As mentioned in the previous section, students had to post one question before each class based on the previous year's VoD lecture. Questions posted ranged from clarification questions (Table 1, rows 1-3) to more complex questions that demonstrated students' analytical thinking. (Table 1, rows 4-5). Often, a student's query would be answered by a classmate (Table 1, row 2).

1	Student 1 - Wednesday, 14 October 2009, 11:06 PM	*What is x0 ä(k+1) in the state space equation?*
2	Student 2 - Thursday, 15 October 2009, 01:01 AM	*If we put n= -1 in the equation, x(n+1)= Ax + Bu, x(0) = x0 , we are getting x(0) = 0 , But it is given above that x(0) = x0 i,e; initially at time zero, state is not zero instead it is x0 . So, if we rewrite the above equation as ,x(n+1) = Ax , + Bu , + ä(n +1)x0 .and put n = -1, we will get x(0) = x0 , which is in agreement with given initial condition.*
3	Instructor- Thursday, 15 October 2009, 06:57 AM	What Student 2 has written is correct. We discussed this topic in detail, with example, in slides 29-30 of lecture 3, on Z-transforms.
4	Student 3- Wednesday, 14 October 2009, 11:26 PM	*Today world is moving towards H, L infinite and FBGA based controllers. Then why do we need to know state feedback controllers? Is there any advantage?*
5	Instructor- Thursday, 15 October 2009, 06:53 AM	The reasons are the following: 1. The pole placement controller is perhaps the easiest feedback controller amongst all advanced controllers. 2. The theory developed in this could be useful to several other controller design techniques as well. 3. All controllers may be viewed as some sort of pole placement controllers.

Table1: Interaction on Moodle

Moodle was also used for more routine activities such as uploading lecture slides, and to communicate updates. A major activity carried out on Moodle was the documentation of the course project work through a Wiki. Each student developed and maintained his/her own Wiki for the project. The faculty member and TAs provided feedback on individual Wikis.

Design of the Study

The course under this study, Digital Controls, was an elective engineering course offered in Autumn 2009 at IIT Bombay. The course was scheduled twice a week for 90 minutes each. It was conducted as a part of Centre for Distance Engineering Education Program's (CDEEP) activity (Moudgalya, Phatak, & Shevgaonkar, 2008). The sample consisted of 14 post-graduate engineering students (13 M. Tech. 2nd year, 1 Ph.D).

The study was designed to formulate a conceptual model of students' affective domain in the ICT-enriched course. For this, data were collected in two stages: 1) through a quantitative survey and 2) through interviews, to gather detailed descriptions about students' own perceptions on the teaching-learning methodology and ICTs used in the course.

A rating scale containing items on Moodle, VoD, classroom environment and teaching methodology was developed and distributed to four experts to check content validity. The suggestions were incorporated and the tool was used to gather data from the 14 students at the end of the semester. To get an in-depth insight into the quantitative data, we conducted a qualitative study. We invited all students enrolled in the course to participate in interviews to learn about students' experience with the course. We conducted semi-structured interviews of four students who responded. The questions were framed to gather data on students' perception about the use of ICT in the course, teaching methodology, interactivity in the course and learning strategies. Each interview was audio recorded, transcribed and coded for analysis according to the method prescribed by Strauss and Corbin (1990).

Findings

Results of quantitative analysis

Table 2 summarizes students' responses on the rating scale. The results suggest that students perceive Moodle to be an important aspect in this course. Responses on the use of multimedia in the course suggested that it was used effectively in the learning process. As the course was recorded live, the classroom setup was different as compared to the traditional environment. A few students found the environment to be distracting during the classroom interaction.

	Agree (no. of students)	**Neutral (no. of students)**	**Disagree (no. of students)**
VoD is good for revision	14	0	0
VoD allows flexible learning	14	0	0
Lectures on VoD enhances understanding	13	1	0
I get distracted by the studio setup of the classroom	5	5	4
Classroom interaction suffers because of the studio environment	4	3	7
Moodle is easy to use	14	0	0
Moodles enables exchange ideas with other students	14	0	0
Moodle is useful during projects	14	0	0
Moodle helps in preparing for the examination	13	1	0
Questions posted on Moodle help to improve my knowledge	14	0	0
Questions posted on Moodle motivates me to do reference work	13	1	0
I like to provide solutions for the problems posted on the Moodle	11	2	0
Instructor encourages active participation of students through Moodle	14	0	0
I feel confident interacting in Moodle only if my identity is concealed	12	1	0

Table 2: Summary of quantitative analysis

Results obtained through the qualitative study

We used a grounded theory approach to construct a model of students' notions about the use of ICT. After coding and analyzing the interview data, two sets of parameters emerged. One was a set of required parameters on which the effectiveness of ICT depends, and the other was the effect of ICT on the learning process of an individual learner. The parameters that characterized students' notions of ICT use in the course were: students' competencies to use technology, instructors' approachability and competencies in ICT-use, availability of ICT-based resources, and the management of course activities.

i) Students' competencies in using ICTs

The course in the study extensively used ICTs as described in the section on Course Framework. Interview data showed that students were not necessarily familiar or comfortable with using ICTs at the beginning of the course, but they learned how to manage the technology as the course progressed. Students realized the value of the technology only as they became proficient at its use.

> Interviewer: How was your experience on working on Moodle?
>
> Student 4: At first we were hesitant to use it, but later on in the course I started using it. I am a TA in another course. There I realized the importance of it. One can get lot of material through it the access previous years material. Asking questions was most important thing I liked, and students can reply to each other!

Students' lack of competencies on technology played an important role in their perceptions of the course as a whole.

> Interviewer: How was your experience in making a Wiki?
>
> Student 3: It was a horrible experience. It was the peak time of the mid-semester and we had a lot of pressure. Making the project and everything else was over, but to post the project on the Wiki took lot of time. So, it was real wastage of time.

ii) Instructor's Competencies

The instructor's competencies in the use of ICTs, and his overall approachability strongly affected students' notions about ICT-use in the course.

Student 3: The best part of the course was if I posted a question, I used to expect an answer from a teaching assistant. But within 5 minutes, the Professor used to reply. I feel that he sits continuously 24 hours on computer.

iii) Availability of ICT-based Resources

Students' survey responses (Table 2) to the use of VoD suggested that it was a valuable resource. They viewed VoD and Moodle, as resources that could substitute a textbook.

> Interviewer: Describe your experience with VoD.
>
> Student 2: If something was difficult, I posted a question. I listened to every lecture [on VoD] twice […] if it is not clear. It was like reading a textbook.
>
> Student 3: If there is one concept in the textbook, in VoD it is 10 minutes. Even if we watch it twice it is 20 minutes, rather than a textbook where you will take a long time.

The hands-on applications of Scilab simulations added to students' enjoyment of the course.

> Student 2: I enjoyed this course because for the theory we learned on Controls technique, codes and simulations were made available soon. We could understand the exact theory by running the code and seeing the results.

The use of ICT-based resources helped students remain engaged with the course content even after completion of the course.

> Student 3: Even after the end-semester exams we were engaged in the projects, posting on the Wiki …

iv) Managing various activities of the course

This course had a variety of relatively new activities and used ICTs that may have been new for students. Every student strongly raised the issue of the course being too hectic, even if they perceived that they learned more. Concerns were raised regarding the completion of other courses, if same teaching method was employed other courses too. Students had mixed responses about VoDs. While students agreed that explanations on VoD were clear, they felt that it was relatively time-consuming to watch VoDs before every class.

> Student 3: For every class, I had to prepare at least 3 hours. It was tough, [I would] forget other things every time this lecture was on.
>
> Student 2: I think we learned maximum because of the format. If the teacher only lectured and we listened, there would be no point. But it was really hectic. I could give this course the required time because I was taking only two courses.
>
> Student 1: … too many things on*e has to do, like see the VoD, post a Moodle question …*

Discussion

Based on interview results we came up with a model of identifying the attributes of students' affective domain and their relationships. Figure 2 shows a diagrammatical representation. The upper half of the model describes the elements of instructional methodology. The lower half describes the elements on which the learning depends on in an ICT enriched classroom instruction as well as the notions of the learners. The key elements in the model are:

Perception about Communication: Classroom and Moodle. The students felt that the classroom interactions were more effective as compared to the offline interactions in the sense that clarification of their doubts was almost immediate. However, a concern about interaction on Moodle was a perceived lack of ability to elaborate on their questions, or seek further clarifications, as is done in a face-to-face conversation.

Perception about blended learning process: ICT enriched instructions. The use of multimedia approach in combination with the learning management system made the learning possible anywhere and at anytime. It aroused curiosity in students to explore content. Students thought that the use of ICT in the instructional process improved their learning skills. Moreover, having a working knowledge of the technologies in use, for both the students and the instructor was a prerequisite to make the learning process enjoyable. The instructor's attitude towards students and technologies was a crucial factor in the success of the blended methodology. Students perceived that even though the blended instructional methodology was useful in learning, it was very time consuming.

Attitude towards teaching methodology: The students viewed this learning experience as beneficial but challenging, due to the ICT-based interactive activities. They felt that they learned not only the content but also how to use Moodle, Scilab and other technologies.

Students like or dislike of use of ICT in the course was based on their prior view of the teaching-learning process. Several active-learning techniques using ICTs were employed in this course. The onus of the work was on the student, leading to the perception of the hectic nature of the course. Students who said they enjoyed hands-on technology use had the view that learning is most effective if they were actively engaged in the process. One student had the perception that anything other than a face-to-face lecture by the instructor meant that the 'teacher was not directly teaching'. This student expressed dissatisfaction with the course.

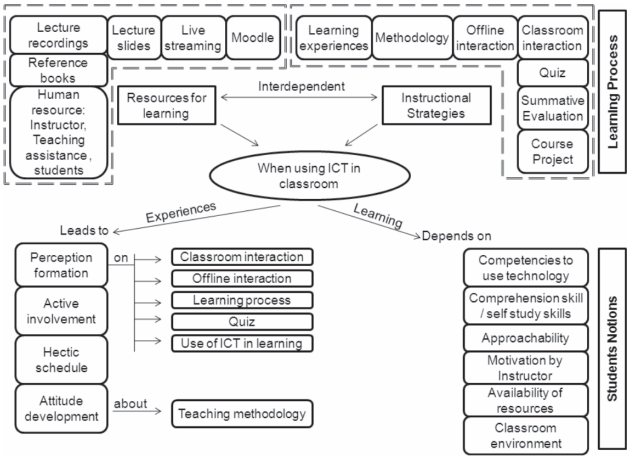

Figure 2: Summary of qualitative analysis

Conclusion

Our study focused on identifying the elements of affective domain in an ICT enriched engineering course at the post-graduate level. The scope of this study was limited to students' notions about the blended instructional methodology in a single course. We found that the use of ICT in the teaching-learning process was responsible for several affective components such as students' overall attitude towards the course, both positive as well as negative. Students' views about ICT use in the course spilled over to their perception of the learning process in general. Successful incorporation of ICT in a course crucially depended on a number of factors such as use of relevant ICT resources to provide hands-on activities for learning, and instructor's competencies in using the ICTs. It helps if students are given the opportunity to familiarize themselves with the technologies. Finally, we note that there are strong interdependencies between students' notions of ICTs used in a course and their perceptions of traditional elements of the course, such as the instructor, and amount of time students need to commit to the course. Studies on the role of ICTs in the teaching-learning process have to consider all these elements in an integrated manner.

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