

IIEECP Intervention in Teaching-Learning Process: An Experience

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Abstract: Many innovative pedagogical practices are having significant influence on effective teaching learning of various courses across the globe. Basic Sciences have an important role to play in building base for core engineering subjects even though they are courses of short duration in most of the Indian engineering institutions. But, it has been observed that students tend to take these courses lightly. The same has been observed by several teachers across the globe. Rizaet al, of UniversitiKebangsaan Malaysia, in their work, mentioned that students see this basic knowledge as difficult and not quite useful. Therefore, it is essential to make some efforts in experimenting with such courses in their design and pedagogical practices. Indo-Universal Collaboration for Engineering Education(IUCEE) and IGIP designed International Engineering Educator Certification Program (IIEECP) provided a platform where many pedagogical practices were introduced to the participants that helped to incorporate them in course delivery and hence make the delivery of content more effective. The main objective of this work is to study the intervention of various pedagogical practices in effective learning and also performance of students. This paper speaks about the implementations of learned pedagogical practices

from IIEECP like active learning, collaborative learning and teaching with technology and their impact in Engineering Chemistry course for freshman students. Results of the study gave a clear impression of improvement in student engagement and learning. In semester and end semester assessment results also support the improved learning.

Keywords: Engineering Education, Basic Sciences, active learning, collaborative learning, freshman, IIEECP.

1. Introduction:

Basic science courses have a vital role in forming essential basis for engineering education. Jerome Karle, Nobel Laureate in Chemistry, in his reports has mentioned about the role of science in engineering developments. Knowledge of Chemistry, one of the basic sciences in engineering, is believed to prepare students to use science and technology in understanding and improving daily lives.

However, mostly these courses are delivered in conventional methods like chalk and talk. This is mostly due to lack of interest shown by students and hence by the faculty. Also, students do not study these subjects in higher semesters of their engineering and hence it is observed that they pay less attention to learn these subjects. However, learning these basics is very important for the students so that they can enhance their application oriented engineering education in higher semesters. Chemistry being one of the basic

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science subjects in engineering faces similar issues.

The course taken for current research has no laboratory sessions as well. So, it was important to give the missing bit of lab sessions in the theory classes itself.

Therefore, it was realized that there is a need to bring up some innovations with respect to design of course, content delivery strategies and assessment.

At the right time, International Engineering Educator Certification Program designed by IUCEE and IGIP provided a platform to learn many effective pedagogical practices which are being practiced across the world. During this course of nine months, various pedagogical practices were learnt and implemented in teaching engineering chemistry for freshman students.

Many activities were introduced throughout the semester. Active learning and collaborative learning were the major activities implemented.

Active learning has already proven to increase student performance in science, engineering, and mathematics. Bonwell and Eison, in their work on active learning, conclude that it leads to better student attitudes and improves students' thinking and writing. Therefore, an attempt was made to bring about such better thinking and writing skills by introducing an active learning activity.

Collaborative learning was the other activity tried. Already it is proven that collaborative learning has been of great help in improvising students' interactive

skills and decision making skills in teams. Development of these skills indirectly helps students in performing better. It is also learned that students who learn in small groups demonstrate better academic achievement, express favorable attitude towards learning, and persist through STEM courses to a greater extent than their more traditionally taught counterparts. Therefore, it was felt that experimenting with a collaborative activity could give enhanced learning environment in the class.

In recent era, students are tech-savvy. They show greater interest in learning and communicating with the use of technology which they use more in their day to day life. It is observed at KLE Technological University that 86% of the students admitted to freshman engineering had smartphones in the academic year 2014-2015. And the number is increasing from year to year, because of staggering decrease in prices of smart phones and internet. Many educationists and teachers across the globe have tried to study the impact of social media technologies on teaching learning process. In the work done by Johnson and George, it is clearly observed that students performance can be enhanced if WhatsApp is used positively. A similar work done by Bounnik & Dshen concludes with better remarks. They in their work have mentioned that WhatsApp messenger to be much more comfortable for students and adults simultaneously than any other social media applications. It has also been observed that such technological interventions help in better exercise of other pedagogic practices.

Technologies like WhatsApp have their own limitations. Sharing data by instructor to the students

Table 1. Active Learning Activity -1

Class topic/sub topic	Activity	Specific question	Details of implementation	Time allotted
Throwing Power: Understanding the equipment set up for the determination of Throwing power of plating bath solution.	#2: Three-Step Interview	Look at the diagram of Haring - Blum cell displayed and figure out the detailed construction with reasoning.	Display a diagram of Haring - Blum cell. Briefly explain what it is used for (5 mins). Give students 1 minute of time to observe and 1 minute to analyze. Then, in a team of three, 1) Student 1 interviews student 2. Student 3 records. (3 mins) 2) Student 2 interviews student 3. Student 1 records. (3 mins) 3) Student 3 interviews student 1. Student 2 records. (3 mins) Members of the team discuss the points they have recorded and prepare one final version of report. (5 mins)	20 Minutes in total.

is very easy. However, collecting assignments, sharing assessment information, etc. becomes cumbersome. Today there are many learning management software which can support the instructors regarding above problems. Google for classroom is a very good open source platform which offers such flexibility. Edmodo is another such platform. Many educationists and teachers have found out Edmodo to be useful for teaching learning Process. In the work done by Gitonga et al, have come to a conclusion that Edmodo can become a very good substitution of conventional methods at least for teachers. Qiusha et al, have observed that Edmodo can significantly improve the effect of science education activities and promote learners' satisfaction.

This opens up opportunities to exploit this technology for sharing course materials and assignments with students in much convenient manner. It was also felt that chat groups like WhatsApp groups will help students get in touch with faculty and peers for continuous and quick learning.

The main objective of this work is to find out the IIEECP intervention in the teaching-learning process. It includes following sub-objectives.

- 1) To check the effectiveness of intervention of active learning in students' performance.
- 2) To check the effectiveness of collaborative learning in improvising students' performance as individual and in team.
- 3) To study the impact of using modern technology in assisting the teaching learning process.

Results of all the experimentation were found to enhance learning process, which are discussed in subsequent part of this article. The results are also quite motivating for further improvisations and innovations.

2. Execution

During IIEECP of nine months, many activities involving different delivery techniques for engineering chemistry course were designed. All activities were designed for a class of 65 students. Before the implementation of any activities, it was planned to examine the impact of the new pedagogical practices. Therefore, an anonymous survey was made to check the level of interest students have in the course. The result of survey can be seen

in Fig.1.

Also, one-minute feedback was taken in all the

How interested are you in learning this course?

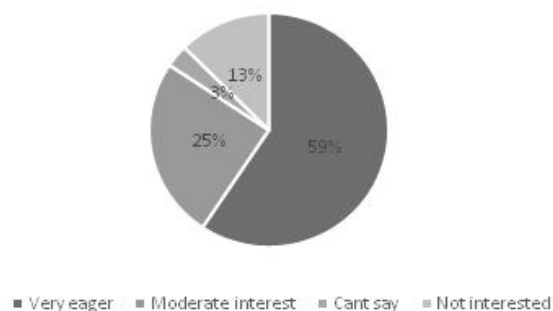


Figure 1. Pre-implementation survey result

sessions throughout the semester asking “how was the class today?” Active learning activities were implemented for over 40% of the topics across the semester. This gave two sets of data. One set for classes without active learning activities and other for classes in which activities were conducted. Analysis of the data is discussed in the results section.

The activities were implemented after the students were well informed about the structure and methodology of the activities. Following are the details of activities implemented.

A. Three Step Interview

Three-Step-Interview technique was implemented as an active learning activity for various topics like chemical bonding, dipole moment, formation of cell, Molecular weight of polymers, Haring-Blum cell, wafer technology, LCD mechanism etc. In 3 step interview there is equal participation and individual accountability for listening, because in the third step each student shares what he or she has heard, and in first two steps, interact in pairs

In the current research, the topic “Haring-Blum cell for the determination of throwing power of electrolyte” is discussed in this paper. Students were divided into 21 teams with maximum of three students in each team. Table 1 was shared with the students to explain the activity in detail. Students prepared notes on what they could interpret and were peer evaluated in the same session as per the rubrics which had 20% weightage for diagram, 80% for construction and working of the cell.

A. Think Pair and Share

Think-Pair-Share (TPS) was extended mostly for all topics that had three step interview activities. TPS is one of the most widely accepted active learning strategy. In the work done by Aditi et al, it has been observed that TPS can help in engaging students in large classrooms. In the current research work, TPS activity for the same topic “Haring-Blum cell for the determination of throwing power of electrolyte” is discussed. Two teams of students were merged to make one team of 6 members. There were 11 such teams in the class to participate in this activity. Table 2 was shared with students for this activity. Teams then presented the inferences that they drew out of discussion and same were assessed by faculty.

B. Collaborative Learning

JIGSAW model was chosen for studying the effect of collaborative learning on students' performance. Francis in his work on has mentioned that Jigsaw can become a wonderful tool in which students naturally develop the interest of working with their colleagues and through that they learn from each other and hence learn better. In the current research activity, 13 teams were formed with 5 members in each team. Students were given a topic 'Formation of electrochemical cell' for this activity. The plan and execution was as in the following details.

- 1) Detailed plan of activity was explained to the students. Teams were formed. Class strength was 65, so 13 teams were formed with 5 students in

each of them. It was made sure that students from different desks were brought in together so that they come out of their 1) comfort zone.

- 2) Students were given either a number/alphabet as identifier.
- 3) Topic was divided into 5 parts and assigned to each member in the team.
- 4) Students were then allowed to learn the assigned topic on their own.
- 5) Students from each group with same number/alphabet were allowed to discuss their topics.
- 6) They then went back to their teams and explained the learnt concept to other members.
- 7) Then they made individual report on the learnings as assignment and submitted it (like Course material).
- 8) They were then asked to revise it in group and submit as group assignment.
- 9) Both individual and group assignments were assessed to check the level of learning.

Rubrics were used for conducting assessment. The parameters used for assessment were, selection of electrodes for cell construction which carried 70% weightage and calculation of EMF carried 30% weightage.

Table 2. Active Learning Activity -2

Class topic/sub topic	Activity	Specific question	Details of implementation	Time allotted
Throwing Power: Understanding the equipment set up for the determination of Throwing power of plating bath solution.	#3: Think-Pair-Share	Now think about the construction of the cell once again in 2 minutes. Meet your neighbor team and share your idea. Discuss it further as team and make a final report on the construction of the cell.	Keep the diagram of Haring –Blum cell displayed. 1) Student again attempts to understand the construction of equipment (2 mins). 2) 3 students of the earlier team now pairs up with the other team. 3) They do a thorough discussion of their points on the topic and prepare one final version of report (5 mins). 4) The team shares their learning with the whole class by presenting their report. (3 minutes /team)	10 min for activity + 03 min for presentation (for each team)

A. Harnessing the Power of Technology

Millennial learners love to learn by seeing the things happening. Therefore, it is important for a teacher to know what tools one can make use of, to supply the need of the learners. The development of technology has made it possible for one to show any process to the students either as an image or video or by virtual reality devices.

Following points mention the use of various technological interventions for teaching learning Process.

- 1) Projector was used extensively to project images, animations and videos of the concepts. It was also used to provide platform for students to present their work whenever necessary.
- 2) In order to avoid paper wastage and also to save time, learning management software called Edmodo was used to share the class notes/course material with the students. Edmodo also is available as an app which made it possible to share information on the go and for students to access information anytime they want.
- 3) WhatsApp group consisting of all students was created. Clear instructions were given in the beginning itself to use the group only to share useful and relevant information to avoid chaos. Students used this group extensively to communicate with instructor as well as their classmates whenever they had doubts. Passing on any notice was also useful through the group.

Results of all these implementations are further discussed in results section of this article.

3. Results and Discussion

It was a great learning throughout the semester for students as well as faculty. Planning for the analysis of IIEECP intervention in teaching-learning resulted in the collection of enough data for analysis.

One-minute feedback collection in every class was helpful in analyzing if the students were enjoying activities or were they happy with the conventional classes. Results can be seen in the Fig. 2.

In Fig. 2 it can be seen that number of students to rate 5 for the classes with active learning activities has

increased when compared to the number of students rating 5 for the conventional classes. Another inference that can be drawn is that number of students to rate 2 and 3 in conventional classes has reduced

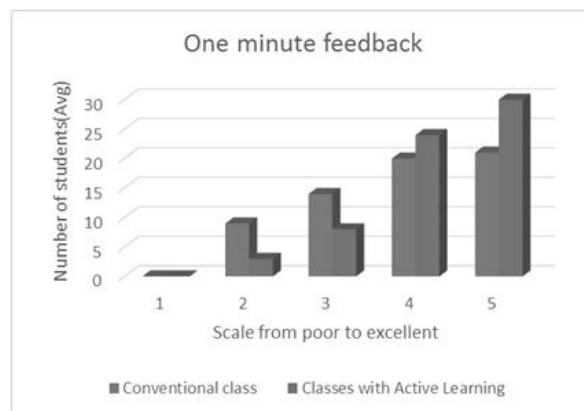


Figure 2. One-minute feedback average scores from all classes, with and without activities

with activities introduced.

A. Active Learning Activities

As per the objective, the effectiveness of active learning component in improving students' performance was analyzed. Average marks for in semester and end semester assessments from two academic years, viz. 2014-15 and 2015-16 were considered for the analysis. Learnings from IIEECP intervened during the academic year 2015-16. Whereas, conventional teaching was in place during 2014-15. Following tables show the comparison.

Table 3. In Semester assessment comparison

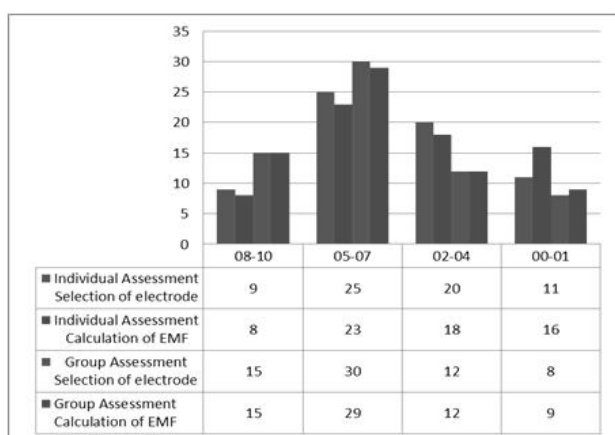
	Minor Exam 1		Minor Exam 2	
Ac. Year	2014-15	2015-16	2014-15	2015-16
Avg. Score	16.01	16.54	15.75	17.01

From the above table, it can be seen that there is marginal increase in the average score, out of 20, of the class in Minor exam 1. This is when students were getting used to the activities being conducted. In minor exam 2, increase of 8% in average marks, out of 20, was achieved, which is when many active learning activities were completed. Comparison of end semester assessment results also shows increase in the number of students acquiring S grade (score > 90%) and A grade (score from 75 – 89). There is also drop in the number of students with F grade (score < 40 or Fail grade). The end semester assessment comparison is indicated in the table 4.

Table 4. End Semester assessment comparison

Grade	2014-15	2015-16
S (>90%)	21%	30.88%
A (75%-90%)	42%	29.41%
F(>40%)	7.04%	7.01%

B. Collaborative Learning

**Figure 3. Collaborative Learning Assessment**

As per the objective again, collaborative learning activities were conducted and assessed to check students' performance as individual and in team.

As discussed in execution section of this article, individual assignments and team assignments were collected from students and were assessed. The performance in both sections can be seen in the following table and graph in the Fig. 3.

Fig.3 shows the number of students scoring between 0-1, 2-4, 5-7 and 8-10 points in the individual assessment as well as group assessment. Assessment parameters are same for both individual and group assignments.

From the numbers in the table in Fig. 3, it can be seen that the number of students scoring in the range of 08-10 points before collaborative activity has increased by 66.66% when they refined their work during collaborative activity. Similarly, there is 20% increase in the number of students scoring in the range of 05-07. This eventually has led to drop in the number of students scoring on the lower side viz. 00-01 and 02-04. Hence, it can be concluded that students had

better understanding of the concept after they were put in a discussion with other students. That hence proves that collaborative learning helped students perform better as an individual as well.

C. Harnessing the Power of Technology

The quantification of improvement in learning through technology is difficult. But surveys have proven that people use WhatsApp extensively as it helps them communicate information easily from anywhere. Therefore, student feedback on the use of technology for assisting the learning sounds apt to derive results in deriving success or failure of the implementation.

Fig.4 indicates that students did find the WhatsApp group helpful for communication of course related matters. Since the group was also under the continuous monitoring by faculty, healthy and useful discussions were observed. Survey was also

Has whatsapp group helped to ease communication of information?

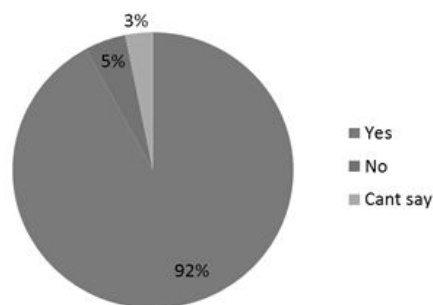


Figure 4. Response of students to the question, "Has WhatsApp group helped to ease communication of information?"

HOW WAS YOUR EXPERIENCES IN USING EDMODO FOR QUIZZES?

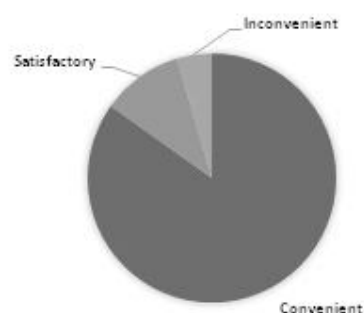


Figure 5. Response of students to the question "How was your experience in using Edmodo for quizzes?"

conducted to check the effectiveness of Edmodo as a learning management tool. Again a student feedback in the form of survey helps in deciding the usefulness of the tool.

From the Fig. 5, it can be seen that 86% students found it very convenient and 11% students found it satisfactory. These numbers for themselves speak about the kind of support Edmodo provided in assisting the learning process. Only 5% students found it inconvenient which was due to moderate skills in using the electronic tools.

Also, overall feedback for the learning experience was collected and following graph shows the results

Fig. 6 shows the overall feedback of the students. It is observed that, 90% of the students agree that the class sessions were excellent when they had some active learning activities.

In support of all the data and outcomes seen in the results, it was also observed that student feedback given to the faculty increased from formative to summative. Formative feedback which was taken before the activities was 90.2% and the summative feedback after the activities was 92.4%.

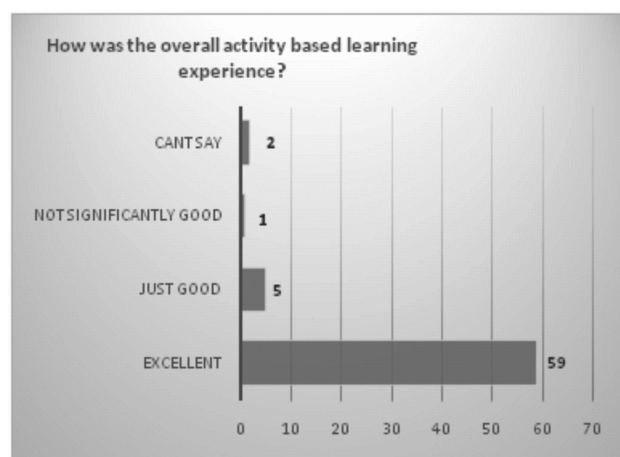


Figure 6. Overall feedback

4. Conclusions

From the results and discussions, several conclusions can be derived. It is clearly evident that active learning activities have had greater impact in the improvement of students' performance in their exams. Collaborative learning activities have helped

in evolving as a better learner through collaboration. For all these to happen, WhatsApp group and Edmodo have contributed by providing a convenient platform for communication and discussion. Therefore, the research work carried out gets a holistic conclusion that making classes more interactive and lively by introducing suitable pedagogical practices. IIEEC has hence been of great help by introducing the universally accepted pedagogical practices to its participants who could experiment them in their courses and come up with enhanced teaching-learning environment.

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