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ANALYSIS OF CO-SORTS BASED ON ASSESSMENT MODULE USING PBL IN PHYSICS

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Abstract: In this paper qualitative analysis of Co-SoRTS based assessment module using Project Based Learning (PBL) in Physics for first year engineering students is presented. We propose an effective interaction and hands on experience with guided creative thinking via PBL which leads students towards research or product development ideas from their initial days itself. A detailed questionnaire was made to collect data for reflections of for students and teachers on PBL. Survey questionnaire helped in collection of data. Data is analysed using multivariate analysis and mixing qualitative-constructivist content analysis. Our Result analysis through questionnaire stimulation indicator, conclude that, maximum positive response is received for working in group 30.3 % and the researching ideas 38.7 % which will indicate an important role in enhancing the Co-SoRTS skills in the students.

Key words - Physics, Project based learning, Engineering students, Skills

Introduction

Skill enhancement and skill development are the challenging areas to focus for 21st century students. Communication, Social skills, Self-management, Research skills and Thinking skills (Co-SoRTS) are the set of abilities related to logical analysis and evaluation of arguments [1]. According to researchers, skill set like critical problem thinking & solving, adaptation of digital media and information technology, leadership in driving a team, inventions and productiveness, vocational learning through self-motivation, understanding of diversity in sociological thinking**,** computer literacy and knowledge of information technology for communication should be complemented with basic skill set of reading writing and arithmetic solving [2]. Students got benefits in developing multiple skills at different levels. For example, through PBL, elementary students learned to understand multiple perspectives and conflict resolution skills [3], special education students developed social skills such as patience and empathy [4], and low-ability students demonstrated initiative, management, teamwork and conscientiousness as they worked in groups [5]. However, positive effects were found to depend largely on the quality of the group process [6].

Accountability and Quality of higher education system can be measured by the percentage of developing individuals/students who are excellent, thoughtful, creative and well-rounded. To get such individuals/students it is very much required:

- to increase the accessibility and enrolment of students in higher education
- to enable students to study one or more specialized areas of interest at an in-depth level
- to reduce the boundaries of choosing specialization and establish a multidisciplinary environment
- to incentivize research or innovation perusal which is the back bone of a developing country (previously it was seniority based)
- to develop character, moralistic and intrinsic values, intellectual curiosity, scientific and creative thinking, service spirit, and the skills of the 21st century across a range of fields, including sciences, social sciences, the arts, humanities, languages, personal, technological and the vocational subjects.

Considering the key role of educator to develop and implement different pedagogies and apply available pedagogies in different way, in this paper, we propose a study and analysis of project-based learning (PBL) pedagogy. Review of PBL evidences, the practicing PBL has started long back, with a

very positive impact on learning in all streams [7-10]. Though PBL results to be effective in terms of developing creative thinking, enhancement in problem solving capabilities, and self-directed learning skills.

Conventionally, PBL is engaging students in real world problem solving and answering complex problems, by involving them on live projects over a long period of time, under the continuous guidance by the teachers [11-13]. Evaluation of their overall skills are done by demonstration of the created product or presentation for an actual spectator. As a result, students develop deep content as well as Co-SoRTS skills [14-17]. Project Based Learning releases a contagious, creative energy among students and teachers by regular one to one physical interaction.

Different pedagogies are practiced as a workable solution. In this paper, we propose a methodology development and qualitative analysis of PBL for Physics. The class room we selected to study, is of first year Physics subject and last year engineering students. Previously, as a conventional PBL, project implementation was always the integrated part of curriculum of engineering final year (last semester) students. Before pandemic, engineering students were facilitated with giving hands on experience on tools, machines, and one to one physical interaction with the mentors/ faculties and their group mates for completion the projects. But for first year students conventional teaching and evaluation in terms of mid-term exams, practical, term end exam were the only options. The technical product generating ideas and involvement in research with critical thinking was lacking for first year students. Even final year students were exposed to work on project [PBL] in their last year of engineering courses. Which could lead a monotonous teaching learning experience for engineering students before their final semesters. In this paper we propose an effective replacement of one-to-one interaction with the virtual interaction and hands on experience with guided creative thinking which leads students towards research or product development ideas from their first year itself. The quality of ideas and research articles generated has been compared as an analysis in virtual-class PBL and normal PBL. Evaluation of the pedagogy is done by taking the feedbacks of the students, research papers published by the students and idea of technical product developed by the students. Product development idea and involvement in the research will surely train the students for understanding research and product development since from their first year itself.

II. Methodology, Data collection and Analysis of PBL

During the first semester of the engineering, the students were asked to implement a PBL method as a part of their Physics course learning. Students never experienced PBL process in their previous studies so, first students are introduced with following steps for implementing PBL: - 1. Start with the formulation of promising and potential Question which can turn out to be a final product, 2. Design a Plan for the Project, 3. Create a Schedule for reviewing status of the project. Visualizing final out at the start of the activity will defiantly motivates the students to explore and learn. PBL need to be implemented as a group activity so, students are instructed to work as a team of four to five. One of the student members could be a mentor or leader for a team. After the discussion among the team, student mentor asked to report the final topic of the PBL activity. Finalizing PBL topic is assisted by the faculty mentors, but the origination of ideas and decisions were made by the students only. A question list was articulated by the mentor based on the project. It was intended to report and observe the sequential development of their work on the regular basis. Importantly, the evaluation standards must be chosen in way that, the PBL projects met all of the targeted points and to achieve grade-appropriate educational standards defined for the course.

The study used data collection through a survey where students reflected their views and experience on PBL, as well as their experience with the mentors. While concluding the semester, a focussed survey was conducted with the students (around 250 students, among which 140 responded), on the experience accumulation for pedagogical practicum: the PBL process. Survey consisted of twelve questions, in which few questions cover the Co-SoRTS skill set, and rest are the interview kind of

questions in which they can elaborate their views (responses provided at the end) without any limits and constraints. It was not possible to conduct one on one interview as the student-mentor ratio was very high. Participation in the survey was voluntary.

Students asked to fill the datasheet as a report too on a weekly basis. Data sheet contains the questions which are reflecting on the process they were experiencing. They are instructed to share the significant views about the process, negative and positive views about the project implementation, what they felt and what they thought about the learning process, as well as what they desired to embrace on to for imminent reference. To make the final conclusion about the PBL process by the students, question list is framed as a non-graded assignment. In assignment report they need to depict their reflections, in details, on learning out comes from the entire process, such as the significance, thoughts and feelings during the whole process, learnings from the procedure, difficulties and the lessons learnt, which might assist them in future. It is taken care that the final grades for the course are unaffected from the performance and participation in this assignment.

As mentioned above, our study model emphasizes our team to focus on the weekly discussions with the student groups about the work status, difficulties and also come up with the solutions to the problems been faced. Some interview questions are also put in the survey to understand the student status since the start of the semester, during the semester and at the conclusion of the semester. Interviews conducted on regular basis concludes the remarkable upwardly trending growth pattern in student's abilities to employ and effectively use project-based learning. The end semester general findings show a professional growth pattern as students became comfortable in creating a project-based learning environment are shown in table 1. We applied multivariate analysis, mixing qualitative-constructivist content analysis [18]. In addition, the consistency and level of quality of this study were confirmed using two methods: (a) triangulation of the research i.e. multiple instruments like survey, viva, personal interviews are used to examine the same research question (as explained above) and (b) meticulous review by the instructor. Brainstorming and discussion sessions were held, focusing on the questions and the relevant data found by each of the mentors. In cases of disagreement, the issue was chased until full agreement was reached.

Table 1- End semester general findings

Student	Beginning semester	Mid-semester	End-Semester
1.	Frustrating, time taking.	Time taking, sometimes annoying.	Still time taking but worth learning through PBL.
2.	Lack of resources.	Time consuming but finding the online resources	Increase in engagement and inquiry.
3.	Difficult to understand.	Collaboration and discussions helped to understand.	Growth in collaboration, communication and critical thinking.
4.	Difficult to connect with lived experiences.	Loved to learn using PBL.	Excitement in learning, fun and created products.

Further to obtain a perspective from the learners regarding the need and effectiveness of the PBL we used during the semester, a survey had been carried out. Survey provided student's perspectives of challenges and supports in the project-based learning process which at the same time supports our new National Education Policy too. The teacher's support was personal and caring as per students. They challenged students and provided responsive guidance and advice. The survey is analysed from the diploma students, engineering students from first year and final year as well. The details are as follows – out of around 300 students 180 have responded, and almost all among 180 students have responded positively for the learning through PBL. It is been observed from the survey that almost 85 % of the

students reported PBL as a major part of their learning throughout the semester. Along with importance of PBL, 80.3 % of the students reported extreme satisfaction in learning through PBL and some want to carry forward the work in the form of research (reported at the end of the discussion), though it is at an introductory level but students were introduced to research during the process, which will help them to build their CV strong in their initial year itself. Table below, shows the percentage of students who favoured PBL for their future growth and present learning along with their likes and dislikes in the whole process.

Table 2. The percentage of students with their likes and dislikes in the whole process

Question to students.	working in groups	creating the product	presenting ideas	researching ideas	presentation / exhibition
What did you like about working on this project?	30.3 %	12.7 %	9.2 %	38.7 %	9.2%
What did you dislike about working on this project?	12.7 %	22.5 %	15.7 %	14.1 %	35.2%

It is quite clear from the data above that maximum number of students like to work in groups and do the research while working through PBL. In all this process the role of mentor is very important and 81% students agree to the same.

Conclusion

Seeding of real-world problem-solving aptitude from first year of the course itself, with regular guidance by the mentor, can develop the new generation with research and product development mind-set. After analysing the obtained results and having discussion on the basis of the relevant theory, it can be concluded that learning using PBL the Co-SoRTS based assessment module further leads student's skills enhancement. Maximum positive response is received for working in group 30.3 % and the researching ideas 38.7 % which will indicate an important role in enhancing the Co-SoRTS skills in the students.

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