Section A-Research pape

IMPACT OF PROJECT-BASED LEARNING AND THINK PAIR SHARE INTERVENTIONS ON UG STUDENTS OF ENGINEERING

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Abstract: The project-based learning intervention was undertaken among the UG students of the Electronics (Instrumentation and Control) engineering stream. A small but self-directed and self-assessed group participated in learning without a teacher's intervention. The idea was not only to propagate project-based learning but also to inculcate think-pair-share values among the students. The intervention was introduced while teaching a core subject of Microcontrollers and Microprocessors. To make the students think outside of the box, a query regarding the MSP430 processor was posed. Since none had prior knowledge, they were asked to gather information. Some students came prepared, but nine volunteered to work (in a think, pair share (TPS) mode) on this Texas processor and then mentored other groups. The group would frequently meet to discuss what they had learned. After operationalizing the processor, the volunteers mentored other groups, transferring what they had learned to other small groups. Thus, it is like an upward-going spring now with the student groups now thinking, sharing and working, i.e. learning without barriers and tutoring each other. A survey was also conducted to study the efficacy of the Think, Pair and Share teaching method. The students strongly agreed that the intervention techniques helped them get involved in teaching and improved the learning process.

Keywords: Project-based learning, Problem-based learning, Think pair share, Engineering Education

1. Introduction

Higher education instructors need to include a more practical component in their mode of lectures to give the students a better grasp of the knowledge being shared with them. One of the techniques being used by the instructors of engineering institutes is to include a practical/industrial problem in their lectures corresponding to the subject or the curriculum component being discussed in the class. In this paper, the impact of using a project-based learning intervention (a modification of problem-based learning) among undergraduate

students of engineering is being discussed. The Think-Pair-Share technique was used in the classroom interaction with the students. The efficiency of this technique has been analyzed as well in this manuscript.

2. Literature Survey

An educational strategy known as project-based learning (PBL) emphasizes learning via participation in a project. PBL exposes students to genuine problems and challenges from the outside world and pushes them to use their knowledge and abilities to address them. (Buck Institute for Education, 2018). PBL has grown in popularity among educators recently, and its efficiency in boosting student learning outcomes has been the subject of much research. This review of the literature will give an overview of the research on PBL and its effects on student learning outcomes.

Its ability to foster critical thinking and problem-solving abilities is one of PBL's main advantages. Studies show that pupils participating in PBL are more adept at applying what they have learned to actual circumstances. (Helle et al., 2006). PBL can also aid students in gaining a deeper understanding of their subject matter because it forces them to investigate and evaluate complicated issues. (Thomas et al., 2018). PBL has also been shown to encourage cooperative learning and teamwork, critical abilities in many occupations. (Kim et al., 2018).

According to academic accomplishment studies, children who participate in PBL outperform those who study through conventional methods of instruction on tests and evaluations. (Al-Ajlan, 2013; Blumenfeld et al., 1991). Additionally, it has been demonstrated that PBL increases student enthusiasm and engagement, which can result in better attendance and lower dropout rates. (Thomas et al., 2018).

PBL, however, also comes with specific difficulties. One difficulty is that it takes a lot of time and work from students and teachers. (Buck Institute for Education, 2018). PBL might be challenging to adopt in disciplines like math and science that call for more conventional ways of instruction. (Thomas et al., 2018).

In conclusion, PBL is a successful educational strategy that encourages collaborative learning, problem-solving, and critical thinking. It has been discovered to improve pupils' academic performance, motivation, and involvement. PBL has drawbacks, yet it is still a helpful teaching strategy that should be taken into consideration by educators.

The three steps of the Think-Pair-Share (TPS) collaborative learning technique are thinking independently, sharing ideas with a partner, and sharing ideas with the entire class. Frank Lyman and his associates created this method in the 1980s to encourage learners' involvement and active participation. The goal of this evaluation of the literature is to evaluate the research studies that have been done on the TPS strategy's efficiency in advancing student learning outcomes.

Three steps make up the TPS strategy. Students are given a question or an issue to consider privately in the first step. Students team up in the second stage and talk with their partners about their ideas. The third step is where the pairs present their concepts to the class. The TPS strategy aims to increase critical thinking, encourage active participation in the learning process, and increase student engagement.

The success of the TPS method has been the subject of numerous research. According to a study by Hennessey and Amabile (2010), the TPS technique was beneficial in encouraging creativity and problem-solving skills among learners. According to the study, pupils who followed the TPS technique performed better on creativity tests than those who did not.

The TPS technique efficiently enhanced student comprehension and recall of course material, according to a subsequent study by Keene and Zimmerman (1997). According to the study, pupils who utilised the TPS technique understood the subject matter better and could recall more information than those who did not.

Additionally, a Johnson and Johnson (2009) study discovered that the TPS technique worked well to encourage cooperative learning and decrease student social loafing. According to the survey, TPS users were more actively involved in their education and more inclined to participate in group conversations.

Despite the favourable results about its efficacy, there are various drawbacks to the TPS method. One drawback is that some students might feel uncomfortable discussing their ideas with their partners or the class. Additionally, if they do not see the connection between the activity and their learning objectives, students might not be motivated to engage in the TPS technique.

The TPS strategy promotes student involvement, critical thinking, and active participation in the learning process. It is a powerful collaborative learning tool. The TPS technique has been found to increase student creativity, comprehension, and retention of the course material. However, this method has drawbacks, including student uneasiness with speaking their opinions and a lack of enthusiasm.

3. Empirical Results

The intervention was introduced in the Undergraduate classes involving 3rd year (Pre-final year) BE Electronic (Instrumentation and Control) students. Two lab-oriented courses ‘Microcontroller-based Instrumentation’ and ‘Microprocessors and Applications’ were selected. The idea behind this intervention was to shift theory-based learning to practical learning; improve students thinking and learning; develop students’ design skills; map theory with lab work; remove inhibition related to designing; encourage mutual dependence and cooperation; to develop mentorship skills. The subjects related to embedded systems always catch the fancy of students and come under the category of specialization subjects. It is necessary for the engineering students of Electronics and Instrumentation (Graduate or

Post Graduate) to have a practical grasp of this subject to fit themselves in the industry/organization dealing with embedded systems applications. With the number of application-related apparatus minimal in the Lab, it was decided to involve the students in active learning and design so that whatever is being taught does not remain in the class but widens their horizon of thinking and applying. The idea is to produce literate graduates and not illiterate and apathetic graduates (Chickering and Gamson, 1987; Hathaway, 2014). The efficacy of project-related active learning in engineering has been well illustrated by Prince (2004). So in a way, the students were motivated to indulge in problem-based learning that would make the learning outcome-based (Woods et al., 2000; Norman and Schmidt, 2000). The teacher acted as a facilitator for information exchange. The students after completing the task acted as mentors for others.

Both the lecture groups in this study had about 55 students. A pause (of 3 minutes) was given 3 times in every lecture to make the students discuss the problem under observation (Ruhl et al., 1987). The students of Microcontroller-based Instrumentation (LTP of 3, 1 and 2) were given the option to select any problem of interfacing/ application with a microcontroller. The students working on a similar application formed discussion groups for TPS. The other groups posed questions to them in order to get a grasp of other related applications. So it was like a win-win situation for all working on hardware problems.
Another intervention involves the 5^{th}-semester students of Microprocessors and Applications. Here to make the students think outside of the box, a query regarding MSP430 was posed. Since none had prior knowledge, they were asked to gather information. A number of students came prepared but nine students volunteered to work (in a think, pair share (TPS) mode) on this Texas processor and then mentor other groups. The group would meet frequently to discuss what they had learned. After making the processor operational, the volunteers mentored other groups on the programming and architectural aspects of the MSP 430 processor. In this manner, the students had a grasp of one another processor which had more practical usage and wider applications than 8085 and 8086 processors.

4. Summary and Conclusions

A survey was undertaken to study the efficacy of the Think, Pair and Share method of teaching. 85.45% of students strongly agreed that this method helps them involve in teaching. Sometimes to involve the students and help them recall the lecture discussed so far, a question was posed to a particular group (randomly chosen) in a pause of 3 minutes. It was just like throwing a cricket ball at a particular student and making him answer the query. The other groups corroborated, contradicted and of course enhanced the answer with reasoning.

A viva voce examination of the students who participated in the project-based intervention performed better than others. The assessment of other groups was done by the students as during my assessment they pointed out the discrepancies in the projects of others.
The problem-related intervention increased not only the attendance of students in the class but as well the questioning and that also not only of the teacher but as well among the groups. The students showed enthusiasm while dealing with the selected problem.

References

Al-Ajlan, A. (2013). A meta-analysis of the effectiveness of project-based learning on academic achievement, attitude, and retention. Educational Research Review, 9, 205-214.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. Educational Psychologist, 26(3-4), 369-398.

Buck Institute for Education. (2018). What is project-based learning (PBL)? Retrieved from https://www.bie.org/about/what_pbl.

Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-based learning in post-secondary education – Theory, practice and rubber sling shots. Higher Education, 51(2), 287-314.

Kim, Y., Lee, S., Lee, J., & Bae, J. (2018). The effects of project-based learning on student academic achievement and motivation in middle school science classrooms. Journal of the Korean Association for Science Education, 38(5), 569-579.

Thomas, J. W., Mergendoller, J. R., & Michaelson, A. (2018). Project-based learning: A review of the literature. OnCUE Journal, 6(4), 10-20

Hennessey, B.A. and Amabile, T.M. (2010). Creativity. Annual Review of Psychology, 61, 569-598.

Johnson, D.W. and Johnson, R.T. (2009). An overview of cooperative learning. In M. D. Cobb & S. L. Topping (Eds.), Research on Learning Groups and Teams: In Search of a General Theory (pp. 3-29). Emerald Group Publishing Limited.

Keene, E.O. and Zimmerman, B.J. (1997). Developing problem solving skills. Educational Psychologist, 32(4), 213-228.

Lyman, F.T. (1981). The responsive classroom discussion: The inclusion of all students. ERIC ED 214-219.

Slavin, R. E. (2014). Cooperative learning and academic achievement: Why does groupwork work?. Anales de Psicología, 30(3), 785-791.

Tucker, B. (2012). The flipped classroom. Education Next, 12(1), 82-83.

Chickering, A.W. and Gamson, Z.F. (1987). Seven principles for good practice in undergraduate education. AAHE Bulletin, 39(7), 3-6.

Hathaway, K.L. (2014). An application of the seven principles of good practice to online courses. Research in Higher Education journal, 1-12.

Prince, M. (2004). Does Active Learning Work? A Review of the Research. J. Engr. Education, 93(3), 223-231.

Norman, G., and Schmidt, H. (2000). Effectiveness of Problem-Based Learning Curricula: Theory, Practice and Paper Darts, Medical Education, 34, 721–728.

Ruhl, K., Hughes, C. and Schloss, P. (1987). Using the Pause Procedure to Enhance Lecture Recall. Teacher Education and Special Education, 10, 14–18.