Impact of Experimental Learning on Graduates Success in Engineering Education

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Abstract: Experimental Learning is an Important learning approach in which students learn by doing it. This research analysed effective learning approach for success of graduates in engineering education. For this experiment 168 students of computer science and engineering from college A and B are considered, where college A adopted Experimental Learning and college B adopted Traditional learning approach. The result is significantly difference in success rate of college A than college B. The course delivery in college A has done by project-based learning which concept of course has been implemented by students by doing projects, solving problems, mini projects for real world problems to find solutions and completing course by doing it practically with involvement of latest technologies. This Experience develops problem solving, creative thinking, leadership qualities, teamwork and ready for industry. Students success is measured with semester end exam (SEE) scores and Placements. This shows college A graduates are successes then college B and also a positive change in individual growth and Organizational. A conclusion is done that Experimental Learning Improve Students' performance and can be implemented in other disciplines.

Keywords: learning, project based learning, students' success, skills, academic.

1. Introduction

Learning Approaches are different for children and adults which develops from supervising by teachers to self-learning out of Experiences. This phenomenon of daily life as being made highly valued to improve success rated in their professional study. World is focusing to implement Experimental learning in Engineering Education System and this proved to Incredible growth in students learning and their success.

Experimental learning is a process of gaining knowledge by experiences. For example, learning cooking does means knowing recipes instead performing recipes, learning science never gives complete knowledge without practicality. Experimental learning is being followed by Century, Aristotle wrote in the 'Nichomachean' Ethics "for the things we have to learn before we can do them, we learn by doing them". As per statistics hundred years ago a learning curve has been formulated by "Hermann Ebbinghaus", which shows a relation between time and memory, in a describe form a student on first day of listening lecture, his learning is 100 percent , on the second day 50 to 80 percent, which gradually decreases 2-3 percent of learning by 30th day. So Experimental Learning has been adopted to make 100 percent for teaching-learning process. Different pedagogies states that experimental learning as a activity based learning, research based learning, internships, project based learning, problem based learning etc..

Proposed work implements project-based learning by integrating different course knowledge with technology in engineering learning, students performing projects is most effective way to implement experimental learning. Their involvement in project makes to gain concept with real time experiences. These projects can be a part of curriculum in multiple stages to test ability and performance of students.

Success of students is measured by parameters like improvement in technical and professional skills, better placements, improvement in academic performance, recognition as a student and as a professional. Analysis is done using t-tests on two populations through the use of statistical examination; two samples considered are small in sizes with normal distributions are not known initially.

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2. Organization of Paper

Section II deals with recent works of experimental learning, Section III deals with research questions faced with proposed work, Section IV deals with case studies and research methodologies, Section V deals with results and validation which concludes the impact of experiential learning on student's success.

3. Related work

Current world requires ahead of technical skills to compete in their career which makes possible with experimental learning, their has been lots research about effective teaching-learning which has been discussed in this section

Author Gokalp [1] Explains that course should be recommended as per verity of learning styles can be applicable, a program should be designed in such a way that all levels should be satisfied with the flexibility of style to learn and to teach.

"Experimental learning is defined by Kolb's [2] as a holistic educational structure and in "the process of creating knowledge by transforming through experiences" this transformation of experiences are occurs in a cyclic manner as students engage in 'concrete experiences (CE)', 'reflective observation (RO)', 'abstract conceptualization (AC)', and 'active experimentation (AE)' [3]. Experiential instruction is characterized by: (a) 'a continuous learning process with experience', (b) 'a process requiring the resolution of conflicts between dialectically opposed modes of adapting to the world', (c) 'a holistic process of adapting to the world', (d) 'learning involves transactions between the person and the environment', and (e) 'a process of creating knowledge [4] says that learning can be viewed as experiential when it is more focused on the process than the products and development of meta-cognitive skills critical to lifelong learning is achieved'. This learning approach increases student satisfaction, deep understanding of subject and develop meta cognitive skills".

"Helm-Stevens, R. & Griego O.[5] experimental learning involves relevant life experiences with a reflection of past for deeper understanding of subject. Students mainly spends time on solving problems, creativity, Thinking".

4. Research Questions

"Following are the research questions that framed for the proposed work through which impact of experiential learning is analysed".

REQ1: "How does course projects provide better learning of concepts of a course?"

REQ2: "Whether projects help students to integrate learning of multiple courses to provide a solution?"

REQ3: "How does project based learning relates to securing placements and improve performance?"

5. Research Methodology

"With the research questions stated above in the section III the authors use simplest experiential learning cycle as shown in Fig. 1 to study the impact of experiential learning in undergraduate engineering. It mainly uses theoretical framework of "do it, observe it and improve it next time". PBL is identified as one of important pedagogy practice to measure the impact of experiential learning".

A. Text Population of the study

"Two institutes are considered for Analyze proposed work. Two groups are selected who belong to department of computer science and engineering at undergraduate level. Impact of experiential learning is analyzed on these mutual exclusive groups.

College A: 'It as an autonomous university has adopted experiential learning through activities, course projects, mini-project, minor project and capstone project at different stages. The scope of this study is limited to two case studies: course projects at second year (Sophomore year) and mini or minor projects done by the students in third year (junior year)'.

College B: 'It is an affiliated college where conventional/traditional approach is followed. Conduction and Delivery process is defined by university. Activities or course projects are not part of their course conduction".

"The research methodology followed is shown in Fig 2. PBL is considered as an important pedagogy [6] which is an impact on academic performance. Quantitative assessment tools such as quizzes, scenario based tests are designed to assess the knowledge and skills obtained through the course. Qualitative assessment tool is designed consists of different questions to know their opinion about the activities conducted as part of PBL. Test and survey was designed using Google forms which provided user friendly interface. The rubrics were designed for evaluation of scenario based tests. Test are evaluated using rubrics and recorded the marks in Microsoft Excel sheet. Data cleaning done by removing null values and not responded entries. Educational Data Mining principles are applied to perform result analysis. Different case studies are identified to address the research questions defined in section III. Conduction of Data structure course helped to address the REQ1, Mini and Minor projects experience helped to address the REQ2 and foundation to achieve success in placements helped to answer the REQ3".

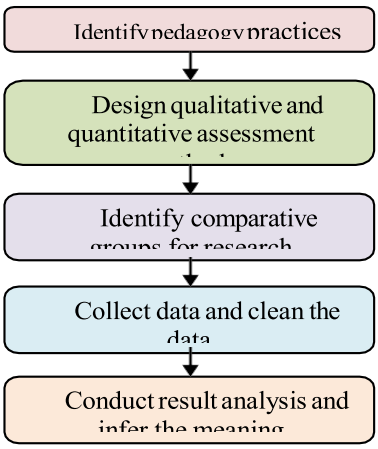

Figure 2. Research methodology

B. Case study for REQ1 – course projects

"Conduction of Data structure course is considered for comparison purpose for both institutes college A and college B.

College A conducted data structure course by designing a course project to provide a solution to

real world problem. Purpose of this is to choose and justify the choice of data structures and implement a solution. An ability of applying knowledge to solve a real world problem is tested using this activity. College B had only laboratory based assignments needed to be carried out in laboratory with 3 contact hours per week. The authenticated students population consists of totally 81 students in which 42 from college A and 39 are from college B. The data is collected from students who have already completed this course and studying currently in third year (junior year) and are capable of answering the questions in a right sense". "Impact of course projects on course learning is measured by three hybrid testing instruments. The data collected is collected and data analyzed".

"Scenario based test: This was designed to test the ability of students to apply the knowledge gained in the course to solve real world problem. It consists of real world scenario where students are required to provide a solution by selecting appropriate data structures and justify the choice of data structures. Scores obtained by students are recorded for quantitative analysis".

"Quiz- a multiple choice based test: The purpose of this was to measure learning's of course. It consists of different questions addressing different levels of Bloom's taxonomy".

"Survey form designed on 5-likert scale: Questionnaire was designed to test the self efficacy level of students about the course. The marks were equally distributed among the three sections with a total of 90 marks (30 per section)".

C. Case study for REQ2 – Mini and minor projects

"Mini and Minor projects are carried out at third year to apply learning of multiple courses to provide solution for real world problem. Authenticated population consists of 91 out of which 47 are from college A and 44 are from college B.

Data is collected from students who are currently studying in fourth year (senior year) and capable of providing feedback in a proper manner. Two hybrid testing instruments are designed , data collected and analyzed":

"Scenario based test: Consists of questions which tested the students' ability to integrate the learning's of multiple courses such as software engineering, data base management systems, object oriented programming and web development which are common for both institutes. Students need to provide a solution in the form of a prototype/ architecture".

"Survey form designed on 5-likert scale: Questionnaire was formulated to test the self efficacy levels of students with respect to the ability to integrate the learning's of multiple courses".

D. Case study for REQ3 – Placements

"Data collected from students who have placed in the industries during their final year. Data is collected using survey form designed on 5-likert scale. Questions were designed to know the self efficacy levels of the students in securing placements by undergoing experiential learning in their career. Survey form used to collect the data regarding REQ2 and REQ3 is shown in Table IV and Table V".

6. Results And Discussions

Although "Two sample T-tests are conducted on data collected from two groups. Equal variance is assumed as the data collected is from two mutually exclusive group of students.

Results obtained through T-test are validated by defining three null hypothesis mapping to three research questions REQ1,REQ2 and REQ3".

- Ho1: "There is no difference in students' course learning in context between the experiential learning and traditional/direct instruction approaches to learning."
- Ho2: "There is no difference in students' ability to integrate learning of multiple courses in context between the experiential learning and traditional/direct instruction approaches to learning."
- Ho3: "There is no difference in students' ability to secure placements in context between the experiential learning and traditional/direct instruction approaches to learning."

"The data obtained from case study A is validated by paired-samples t-test corresponds to null hypothesis Ho1. There was a significant difference in the scores obtained through study as shown in table I. The results suggest that null hypothesis Ho1 can be rejected and proves that there is significant difference in the course learning of students who have undergone experiential learning and traditional learning".

TABLE I. DATA ANALYSIS FOR REQ1

Parameters	**College A**	**College B**
Mean	67.33	44.60
Standard deviation	6.56	8.17
Variance	43.00	66.77
N	42	39
Conditions: t(79) = -13.86, p =0.00(p<0.05).		

"Data collected by case study B is validated by paired-samples t-test corresponds to null hypothesis Ho2. It also shows the significant difference in the scores obtained. Scores are shown in table II. These results suggest that null hypothesis Ho2 and there is significant difference in the ability of students to integrate learning's of multiple courses to provide a solution in context between the experiential learning and direct instruction approaches".

TABLE II. DATA ANALYSIS FOR REQ2

Parameters	College A	College B
Mean	68.60	45.52
Standard deviation	3.35	4.72
Variance	11.20	22.30
N	47	44
Conditions : t(89)=27.02 p =0.00(p<0.05).		

"Null hypothesis Ho3 is validated by analysing the data collected by survey of fourth year students to measure self efficacy level to secure good placement. There is a significant difference in the scores obtained due to experiential learning which helped in the placements as shown in table III. The results suggest that null hypothesis Ho3 can be rejected and there is significant difference in the ability of students to secure placements of students in context between the experiential learning and traditional/direct instruction approaches. Placements statistics also show that college A has attained 96% placements and college B attained only 50%".

TABLE III. DATA ANALYSIS FOR REQ3

Parameters	College A	College B
Mean	21.82	8.81
Standard deviation	1.69	1.88
Variance	2.88	3.541
N	47	44
Conditions: t(89)=34.65, p =0.00(p<0.05).		

7. Conclusion

Although "The study presents quantitative and qualitative analysis supported by hybrid assessment tools. The results indicated that there is a statistically significant difference among two approaches of teaching-learning processes - experiential learning and traditional instructional approaches.

Experiential learning proved to be an effective teaching-learning means to improve individual competencies, ability to work in team, potentiating their personality and taking them closer to reality. Results of the T-test clearly indicated that there is significant improvement in the ability of students to apply the course learning's to provide a solution.

There is ample evidence that adoption of experiential learning possessed greater confidence in facing interviews and achieve placements in companies, improved professional and technical skills and accelerated student's learning. PBL helped to bridge the gap between theory and practice, increased engagement levels in a study, enabled personalized learning and improved student's demonstrable mindset.

The methodology arouses a spirit of investigation and innovation, creativity for the generation of new knowledge, productive thought, and motivation to learn and solve problems .

The results of this study have implications for potential positive change on the individual, organizational, and at the societal level. At the individual level, experiential learning improves his confidence level to take up any task and complete it. At the organizational level, it seeks to build competency in PBL and has potential to attract funding. At the societal level, it creates better employable engineers.

But some factors like interpersonal skill of a student, the college infrastructure and teacher influence the learning method and thus the results of the study. Future scope includes identifying the student's skills and suggesting suitable courses, company or identifying weak skills and suggesting improvements using education data mining based on the data collected".

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