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Enhancing Constructive Learning by Integrating Theory and Practice

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Abstract: Active learning and experiential learning are two sides of the same coin. One side highlights on self learning (cooperativeness) and other side learn by doing (experience). Now a day's technical education needs a new approach in student learning. This paper provides the information of teaching learning process which bridges the gap between theory and practice. It is found that many students lack in understanding the basic concept engineering, on time refreshing and regular interaction help students to understand the concepts in a better way. Integration of theory with the laboratory will cause an experiential learning for student. If course project is included, it causes active learning where students start working in teams. The main goal of this activity was to expose PG students of Production Management in areas like Design, Fabrication, Testing and Analyzing the 'Setup' or 'Automatic Machine' prepared during the course time. Assessment is done systematically and Program outcomes (PO3, PO5 PO6 and PO10 of NBA for PG program) were addressed by the way of the task given to the students. The idea here is to generate a platform for their creative work. The students were grouped (heterogeneous group) based on their previous ranking. The project was successfully completed on time and students got good practical exposure about the components and its complexity for proper functionality. It is also quite evident that the quality of answers in the main examination (SEE) showed a remarkable improvement because of meaningful and transferable 'constructive learning'.

Keywords: Active Learning, Constructive Learning, Regular Assessment, POs (NBA)

1. Introduction

Teachers in professional fields desire their students not only to learn the theory and understand, but also check how theories are important to apply in practice (Clapton et al, 2006).Students experienced most vividly when they went out on placements, where 'academia' (theory) and 'the real world' (practice) were unhelpfully counter-posed. What was highlighted was the apparent split between the classroom and the field. The literature says that attempts can be made to overcome this problem by introducing an active learning (practice) in the course. Active learning shifts the focus from the teacher and his delivery of course content to the student and his active engagement with the material or project. Through active learning techniques, students drop the traditional role as

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passive receptors and learn and practice how to apprehend knowledge and skills and use them meaningfully. Active learning involves providing opportunities for students to meaningfully talk and listen, write, read, and reflect on the content, ideas, issues, and concerns of an academic subject (Meyers & Jones, 1993). Content expertise and active teaching and learning will provide students the opportunity to become engaged learners and dynamic thinkers. Mendenhall (2007) says that classroom's success is only achieved by "learning into practice and practice to learning".

According to Hutchings (1990) and Shebib (2003), learners need to have skills in areas like relationship building, exploring or probing, empowering, challenging and proper communication / presentation. The course Mechatronic system (task)consist of mechanics (Mechanical Engineering), electronics (Electrical Engineering) and computing (Computer Science) which, combined, make possible the generation of simpler, more economical, reliable and versatile systems. This puts a platform for the production management students to think towards bringing automation in manufacturing industries. This subject is alternatively being referred to as "Electromechanical Systems". Much of this course is a refreshing material with the application. Since it is a technological subject, it is essential that students keep updated with the latest information. There should be liaison between assumption (theory) and reality (practices).

Problems identified (in conventional teaching process):

1. Students join PG programs from different institutions with different discipline
2. Student were lack of knowledge from previous subjects
3. The amount of information retained by students declines substantially
4. Students will not learn what they don't care about and will not remember what they don't understand.
5. There was no exposure about Mechatronics components and its real time interfacing

B .Objectives

During the course student should be able to:

1. Discuss the advanced approaches in Mechatronics system design and its application in manufacturing.
2. Propose a Mechatronics element to provide correct information about particular process and outline its operational capabilities
3. Comprehend operational capabilities of advanced drives for sophisticated CNC machine tools for manufacturing
4. Develop a hydraulic/pneumatic circuits with necessary elements with specification for various machine tool for modern manufacturing
5. Discuss the importance of CNC and special purpose machines and robotics in manufacturing.
6. Describe and analyze the various signals and interfacing methods to real time system.
7. Figure out the importance of PLCs and summarize future trends in Mechatronics
8. Design and test simple Mechatronics product consisting necessary components.
9. Demonstration of issues positively

Problem definition and title:

Integration of theory and practice in the course 'Mechatronics System' for production management students for proper learning

C.Literature Review

According to Boud et al. (1993), self learning as using instructional activities involving students doing things and thinking about what they are doing. Some characteristics of active learning are

- Students are involved in more than listening
- Less emphasis is placed on transmitting information
- and more on the development of student's skills
- Students are involved in higher order thinking
- (analysis, synthesis, evaluation)
- Students engage activities (such as writing, reading, discussing, and observing)

Meyers & Jones (1993) infer that the activities that allow students to clarify doubts, technical question, consolidate answers, and gaining appropriate new knowledge encourage their participation and confidence in their learning abilities. Students will quickly determine their contributions in subject as activities get continued as shown in Figure No 1

Figure 1: Project Based Learning

Source: Experiential learning. Englewood Cliffs, Prentice-Hall

D. Methodology

Methodology used in cultivation of self learning in Mechatronic System Course

1. Awareness of the activity: The purpose of the course project is to give the student an opportunity to apply the Mechatronics system design concepts learned in the classroom Students are initially educated about the activity and what is expected towards the end of the course completion. Some of the project activities done by previous year students and their success level are presented.
2. Batch Formation: It is expected that each member of the team contributes his/her technical knowledge and skills to have a winning team. Students were selected based on their past academic scores. It was ensured that each batch consists students of all levels. The problem was finalized after batch formation.
3. Display of schedule: Beginning of the activity was done by putting the schedule for the task to be completed. This will accelerate team cohesiveness, build trust and require teamwork in a batch. The activity can be planned and designed to give the team opportunities to experiment with the available material collected for the project at the right time.
4. Assessment method: The regular interval review was conducted to check the progress of the work and during the period of time correlation of theory with practice was made by a staff member
5. Instruments and Measures: Project Assessment Rubrics were made which focused on program out comes (PO: 3, 5, 6, 10)
6. Assessment Results: Assessment results are used to provide feedback to students addressing positive and negative issues of the course project (Process applied as shown in Figure No 2)

Figure 2: Assessment process

Source:Boydston, Southern Illinois University Press.

Learning Outcomes for Course Project (LO):
At the end of the topic student should be able to:

TLO's	CO's	B L	PI Code
Design and demonstrate the working model of the mechatronics system	8	L4	3.1.1,3.1.2,3.2.1, 3.2.2 6.1.1,6.1.2 10.1.1,10.1.2,10. 2.1,10.2.2
PO-Programe Outcome CO-Course Outcome TLO-Topic Learning Outcome BL-Blooms Taxonomy PI-Performance Indicator			

E. Observation and Discussions:

Following remark can be made after implementing an integrated approach to the course 'Mechatronic system'

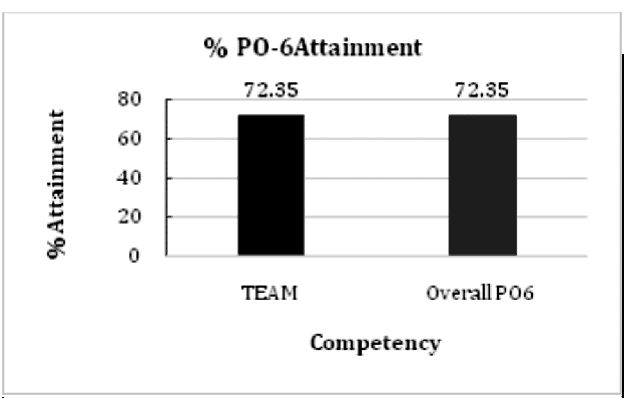
For Teacher:He /She can apply an affective counseling method to serve the students by facilitating and solving various problems. Sharing knowledge from experience and provide information from literature, discussions, exercises, cases, etc.

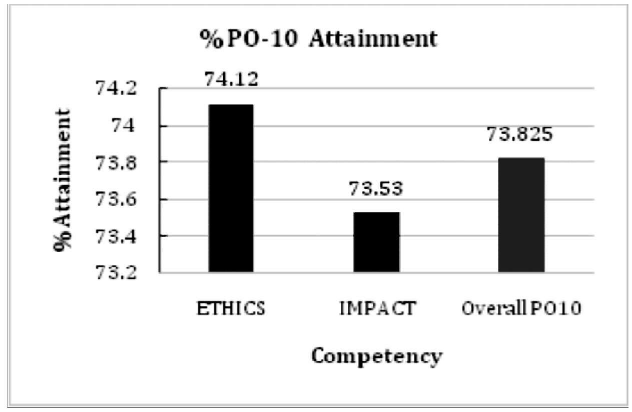
For Students: Reflects on knowledge gained from listening to teacher, guest speakers, experts, and other Students; Reading Textbook; and Various Other Activities and Sources. Observes students interacting in groups, making presentations, analyzing cases, and engaging in role-playing exercises in the classroom.

Below (Table No: 1) the activities which are observed important during the course of time in Mechatronics system

Table I: Key Activities

Active learning
Responsibility for their own learning
Working in pairs
Co-operative learning
Produce short written exercises
Unlimited learning
Experiential learning
Receiving and processing information
Learner experiencing ,learning
Reflectively and activity
Limited learning
Problem Based Learning
Cognitive approach





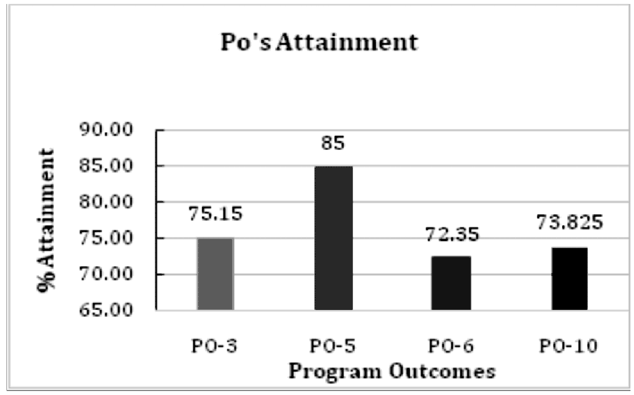


Figure 3: Aseement charts

Assessment is done for the attainment of program outcomesPO-3, PO-5, PO-6 and PO-10. The competency for the outcomes are as follows.

i. Need.
ii. Conceptual
iii. Modern Tool
iv. Team
v. Ethics
vi. Impact

Students were evaluated for each of the indicators through demonstration, presentation and viva-voce examination. The attainment for each of the competencies of all PO's (3,5,6&10) were recorded. It was found that the overall class attainment of program outcome as follows

Table 2:PO Attainment

Program Outcome	% Attainment
PO-3	75.15
PO-5	85.00
PO-6	72.35
PO-10	73.825

Laboratory helped the students in a deeper understanding of the experiments and increased the analyzing skills among the students , apart from this activity helped the students to understand the industrial problems.

There was a surprise improvement in student's answers (Refer Figure No:4) in the final examination,where student were comfortable answers L3 and L4 level answers which was not so in the previous year exam. This happened because of the best practice adapted for mining the information during course project. The students here successfully gained the knowledge and learning happens

Table 3: Blooms Level Attainment

Question	1.	2.	3.	4.	5.	6.	7.
Blooms Level	L3	L3	L3	L3	L3	L4	L4
CLO	CLO2	CLO4	CLO4	CLO5	CLO7	CLO8	CLO8
Max. Marks	10	10	10	10	10	20	20
Avg. Marks	7.82	4.85	7.07	7.73	7.07	16.41	0
Percentage	100	76.47	82.35	88.24	88.24	100	0
% Attainment	78.24	48.46	70.71	77.33	70.67	82.06	0
Act. Attainment	78.24	37.06	58.23	68.24	62.36	82.06	0

G.Conclusion

Finally it is noticed that acitivity based learning makes understanding better than conventional learining. Text books only provide the information about the topic which has been already proved .But literarture survey during the ctivity will strengthen the knowledge of the students and make more compitative.

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Appendix:

Competency (PO's)	Performance Indicators
2.1 Synthesize information on the implementation of modern trends in manufacturing management in different industries	2.1.1 Literature survey to synthesize information through case studies
2.2 Select and Analyze a case study	2.2.1 Identify the challenges highlighted in the case study
	2.2.2 Analyze the inherent causes
3.1 - Recognizing the needs and understanding the societal issues concerned with public health, safety, societal culture and environment.	3.1.1 - Identify the issues/problem concerning public health, safety, societal culture and environment.
	3.1.2 - Set the objectives to address the above issues.
3.2 - Conceptualize a system/process to address public health, safety, societal, cultural and environmental issues.	3.2.1 - Conceptualize system/ component/process/ solution to address public health, safety, societal, cultural and environmental issues
	3.2.2 - Validate the solution through simulation/prototyping.
5.1 Possess competence to use the modern engineering tools of manufacturing engineering/management to address the manufacturing related problems.	5.1.1 Identify different modern engineering tool/ tools in manufacturing engineering and management fields.
	5.1.2 Evaluate the tool/tools for appropriateness to address the identified problem.
	5.1.3 Select and use the modern tool/tools in synthesis/analysis, computer simulations for system/process design, modeling and optimization.
	5.1.4 Discuss the inferences and conclusion.
6.1 - Actively participate in team activities as member in discussions and consolidate the ideas and contribute the decision making process	6.1.1 - Work efficiently as an individual and effectively as a member in diverse multi disciplinary project teams.
	6.1.2 - Demonstrate effective leadership traits
10.1 - Ethical considerations while deciding on alternatives to solutions in their professional area.	10.1.1 - Understanding the norms of business/professional ethics.
	10.1.2 - Consider the ethical norms in professional decision-making.
10.2 - Degree of awareness of the global, economic, environmental and societal impact of engineering solutions in product and process design.	10.2.1 - Recognize the impact of professional decisions regarding product/process design on the society and ecology
	10.2.2 - Consider the societal and ecological constraints in the product/process design

PO1 Scholarship of Knowledge: Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyse and synthesise existing and new knowledge, and integration of the same for enhancement of knowledge.
PO2 Critical Thinking: Analyse complex engineering problems critically, apply independent judgement for synthesising information to make intellectual and / or creative advances for conducting research in a wider theoretical, practical and policy context.
PO3 Problem Solving: Think laterally and originally, conceptualise and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and enviro nmental factors in the core areas of expertise.
PO4 Research Skill: Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and vie w things in a broader perspective, contribute individually / in group(s) to the development of scientific / technological knowledge in one or more domains of engineering.
PO5 Modern Tool Usage: Create, select, learn and apply appropriate techniques, resou rces, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6 Collaborative and Multidisciplinary work : Possess knowledge and understanding of group dynamics, recognise opportunities and contribute positively to collaborative multi-disciplinary scientific research, demonstrate a capacity for self - management and teamwork, decision-making based on open - mindedness, objectivity and rational analysis in order to achie ve common goals and further the learning of themselves as well as others.
PO7 Project Management and Finance: Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after considerisation of economical and financial factors.
PO8 Communication: Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
PO9 Life-long Learning: Recognise the need for, and have th e preparation and ability to engage in lifelong learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
PO10 Ethical Practices an d Social Responsibility : Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
PO11 Independent and Reflective Learning: Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without dependin g on external feedback.