

Enhancing Student Learning through Integrated Course Project Activity

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Abstract : This paper examines one aspect of the curricular change process undertaken in the undergraduate level in which the inclusive learning community structure changes and support the learning of the students. Many different kinds of student learning are evident in our interview data. A major benefit for students is learning to work in teams, soft skills, directed learning and while all of them spoke of the difficulties involved. The initial changes of the courses are integrated as a course project where the students are interviewed the different aspects of the course in-order to achieve the graduate attributes. In this paper we describe how we carried out the development of integrated course project, So this integrated course project looks at building a network domain applications and realization of basic networking protocols. This integrated course project provides a flavour of combining the Computer Network and Operating System Courses. The conduction of the assessment realizes the students to enquiry the courses in depth and correlate the concepts to a real world problems.

It places the responsibility on the individual student to initiate and direct the learning process which provides the contextual environment that makes learning exciting and relevant for the appropriate course. It also provides an opportunity for students to explore technical problems from system level perspective to implementation level. The integrated course also emphasis considerable use of computers in an active learning environment that stressed teaming and other quality tools.

Keywords: Graduate Attributes, soft skills, Computer Networks, Operating System, tools.

1. Introduction

The conventional method of teaching incorporates the assessment of project for an individual subject, where a student needs to carry out project separately for respective courses, during their process of evaluation with a students, we came to know the problems faced by the students during their course project review was that less time, correlation, mapping and delivery methodology. In order to build the gap of this approach, we introduced an integrated course project methodology it enhances the effective learning of the students and correlation of the courses and its importance in the real time scenario. This methodology reduces the workload of students, provides a platform to work in a team and mapping of the concepts taught in one course to another course.

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We at BVB College of engineering and technology are in the process of review and carrying out integrated course activity for the two core courses like operating system and computer networks in the curriculum design during 5th semester of 5 credits each and delivery process to achieve Outcome Based Education (OBE) system [1]. The process began with formulating OBE for information science program and the mapping of PEO to program outcomes is as illustrated in the below Table 1.

With this approach student realizes the effectiveness of individual course on real time application and develop the ability to choose an appropriate concepts to carry out integrated course project. The attainment of outcomes with integrated course project can have a high impact on the student's performance in their SEE exams and other aspects of the lifelong learning abilities.

The integrated course project work is a major contribute towards achieving program outcomes (1, 2, 3, 10) of two courses illustrated in Table 1, hence a well designed integrated course project would have a high impact on achieving OBE.

Project Based Learning:

The main objective of carrying out an integrated course project is to motivate students to develop different types of system based applications focusing on operating system and computer networks concepts, utilizing the knowledge to achieve the following said goals:

1. Identify & the issues and challenges in network based applications.
2. Develop problem solving and analysis skills to analyse different QoS parameters.
3. Implement code to build network topology using different simulation tools.
4. Learn to apply various system calls and functions of operating system for system development
5. Apply networking and system call, scheduling concepts from operating subject to schedule the computing resources in client server environment.

In project-based learning, students work in groups to solve the problems that are open-ended,

curriculum-based. Firstly, students carry out need analysis to identify the need of problem statement in day today life. Then they evaluate the problem statement to check technically it is feasible to implement all the required resources are available or not then they look for a solution based on their prior knowledge. The main goal of integrated project based learning is to make the learning environment student-centric. Engineering students need an opportunity to apply their knowledge and skills to design and develop applications or issues related to our social life [3]. This can be attained through project based learning approach. Once the students develop project based learning skills then they will be engaged in self-directed study, peer learning.

I. Outcome Based Education

OBE is defined as a "comprehensive approach to organizing and operating an education system that is focused in and defined by the successful demonstrations of learning sought from each student" The convention method of teaching replaces with an OBE methodology as shown in Table 2. It is a process that involves the restructuring of curriculum, assessment and plan of execution to reflect the achievement of high order learning. Thus the primary aim of OBE is to facilitate desired changes within the learners, by increasing knowledge, developing skills and/or positively influencing attitudes, values and judgment. OBE embodies the idea that the best way to learn is to first determine what needs to be achieved [4]. Once the end goal (product or outcome) has been determined the strategies, processes, techniques, and other ways and means can be put into place to achieve the goal.

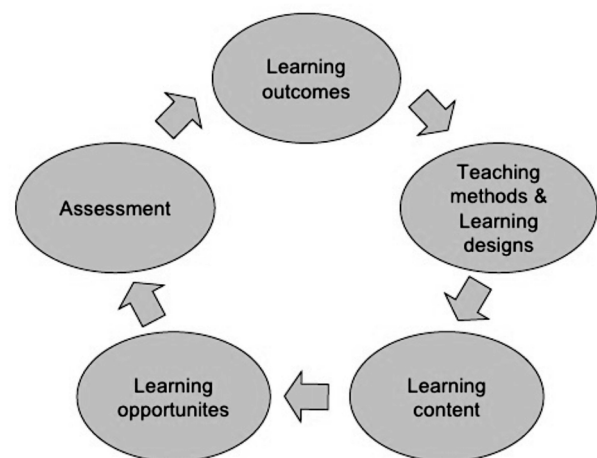


Figure.1: OBE Cycle.

Outcomes are clear learning results that learners have to demonstrate at the end of significant learning experiences: what learners can actually do with what they know and have learned. Outcomes are actions/performances that embody and reflect learner competence in using content, information, ideas and tools successfully as shown in fig.1.

Table .1. Program Outcomes and PI Mapping

Attribute 1: Engineering knowledge		
Competency	Indicators	Weight age in %
1.4 Demonstrate competence in Computer Science Engineering	1.4.1 Apply theory and principles of computer science to solve an engineering problem	20
Attribute 2: Problem analysis		
2.1 Demonstrate an ability to identify and characterize an engineering problem	2.1.1 Evaluate problem statements and identifies objectives	10
2.2 - Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.3 - Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions 2.2.4 - Compare and contrast alternative solution/methods to select the best methods	30
Attribute 3: Design/Development of Solutions		
3.1 - Demonstrate an ability to define a complex open-ended problem in engineering terms	3.1.4 - Ability to choose appropriate quality attributes as defined by ISO/IEC/IEEE standard.	10
Attribute 5: Modern tool usage		
5.1 - Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.2 Create /adapt/ modify/ extend tools and techniques to solve problems.	10
Attribute 10: Communication		
10.1 - Demonstrate an ability to comprehend technical literature and document project work.	10.1.1 - Read, understand and interpret technical and non - technical information.	10
10.3 - Demonstrate the ability to integrate different modes of communication.	10.3.1 - Create engineering - standard figures, reports and drawings to complement writing and presentations.	10

The table 1 depicts the Program outcomes (PO) and Performance Indicator (PI) and Percentage of marks weight age given to measure each of the PO and PI of Computer Networks and Operating system course, which in turn are used to evaluate integrated course project[2].

Table.2. Comparison of Content Based learning system and OBE

Content Based Learning System	Outcomes Based Education System
Passive students	Active learners
Assessment process exam & grade driven	Continuous assessment
Understand and remember	Critical thinking, reasoning, reflection & action
Content based/broken into subjects	Integration of knowledge, learning relevant/ connected real life situations
Textbook/worksheet focused & teacher centered	Learner centered & educator/ facilitator use group/ teamwork
Emphasis what teacher hopes to achieve	Emphasis outcomes what learner becomes & understands
Previous knowledge & experience in learning field ignored – Each time attends whole course	Recognition of prior learning: After pre-assessment, learners credited outcomes demonstrated or transfer credits elsewhere

3. Integrated Course Project Learning Model

The proposed method is to carry out ICP by a student centric learning, where outcomes of the respective courses are clearly defined at the beginning of the course. The roles of faculty and students are clearly distinguished to achieve the program outcomes [7].

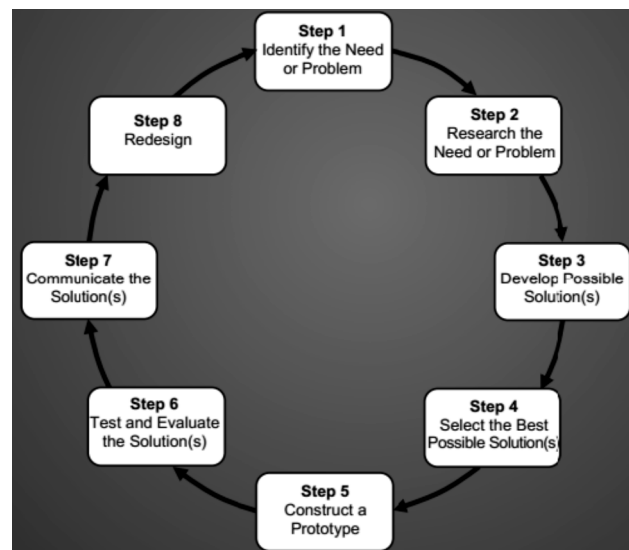


Figure 2. Project Development Model

The figure 2 shows the different steps carried out to design and develop the application/system. It mainly consists of 8 steps:

Step 1: Need Analysis: Identify the need of problem or issues in day today life by carrying out the literature survey

Step 2: Problem Evaluation: Evaluate the problem considering technical feasibility, resource availability, time and other constraints.

Step3: Propose Solutions: Need to design the alternate solutions for the proposed problem considering all functional and non functional requirements.

Step 4: In this step we need to select the optimal solution meeting all the requirements

Step 5: Implementation will be carried out in this step, firstly low level system design will be done were we will write the algorithms for each of the modules and then we will implement each of the modules.

Step 6: Testing: once each of the modules is implemented we perform unit testing on each of the modules to check weather it is giving correct output for the given input data and then we validate the modules.

Step 7: In this step we build the report and deploy the application and check for the results

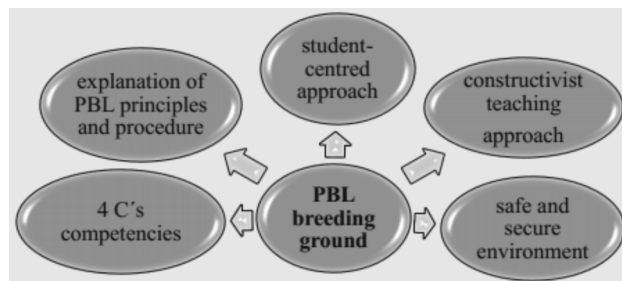


Figure 3. Project Based Learning Approach

Step 8: Redesign: If the deployed application doesn't work appropriately or doesn't give required output or the performance is not that efficient then we look for the alternate design.

The figure 3 shows project based learning model which follows student centric approach. Integrated Project Based Learning is an innovative model for teaching and learning. It focuses on the combining concepts and principles of a discipline, involves students in problem-solving investigations, allows students to work autonomously to construct their own knowledge through inquiry, and culminates in a realistic hands-on project.

A. Teacher's Role:

The role of the course instructor is to brief about the impact of ICP in lifelong learning abilities and also define the outcomes clearly, so that their should not be any ambiguity in carrying out the project work, to achieve program outcomes of the courses as shown in table 1. The following are the points, on which the course instructor has to focus on.

- Analyze the concepts/techniques chosen by the students to check whether they are relevant to develop the project
- The expectations, learning outcomes and goal of the project must be clearly defined and conveyed to the students before start of the project.
- The evaluation procedure, timelines and the evaluation rubrics must be clear discussed
- The program outcomes and the performance indicators elements assessment score will be used to measure the learning of the students

The following strategies have proven to be effective for all students who are keen in learning new technologies or to develop applications:

1. Clearly specify the expectations and frequent reminders regarding each aspect of the projects, considering student's learning preferences.
2. Make sure peer learning happens in the group, give them individual attention or pair them with other students so that learning happens.
3. Provide opportunities for multi-modality learning throughout the project.
4. Offer opportunities for students to interact with the ideas and solutions

Specific challenges facing teachers include:

- Recognizing situations that make for good projects
- Structuring problems as learning opportunities
- Collaborating with colleagues to develop interdisciplinary projects
- Managing the learning process
- Integrating technologies
- Developing authentic assessments

B. Student Role:

The role of the student is to understand the relevance of the course to develop the project. Students must be clear with the learning outcomes, evaluation procedures and Rubrics set by the course instructor. Project work makes students to understand in-depth of subject and they translate the information they discover to real knowledge and then share with others. ICP provides opportunities for investigations and presentations. Students identify real world problems/issues to pursue and they investigate them through real-world sources of information. Collaborative and peer learning skills will be developed and finally projects enable students to be active learners.

Students role to implement the project are as follows: Form a team of 4 members and discuss among the team on the issues/limitations in the existing system or any social issue which can be address through these courses [10]. Choose the domain in which they want to do the project define the problem statement and evaluate the requirements

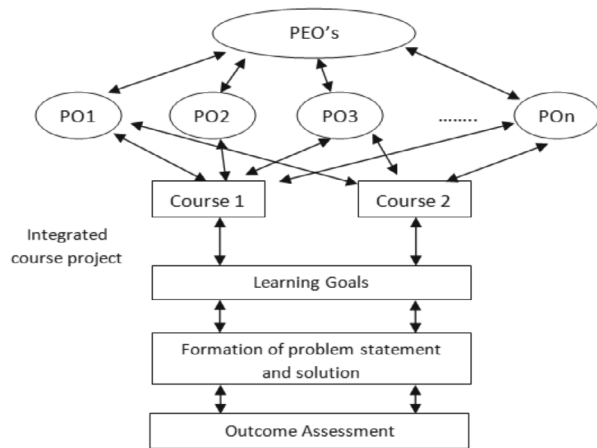


Figure 3. Student Learning Model

- Propose the solution plan with alternate designs and implementation constraints
- Apply the knowledge of one course in realizing the concepts of another course, correlate the concepts to understand the requirements and to develop the project
- Understand the importance of integrating two course concepts/ techniques to develop project and perform performance evaluation
- Finally prepare technical report and presentations.

The figure 3 shows the student learning model for integrated course project. Lecturing is without doubt effective for transmitting information but if we wish to develop thinking skills, problem solving abilities and lifelong learning skills a more student-centered approach need to be considered. Project-based learning and problem-based learning share several characteristics [10]. Both are instructional strategies that are intended to engage students in authentic, "real world" tasks to enhance learning. Students are given with open ended projects or structured enquiry problems where they can use more than one approach to solve the problem. The different steps involved in student learning model are as follows:

Step 1: Identify Appropriate Concepts/Techniques

An initial step in designing an integrated course activity is to identify the problem or issues relating to social world, conduct the investigation on the identified problem on its need and importance, then apply the concepts and correlate them to design the model.

The following points need to be considered:

- Equal importance need to be given for both the courses
- Challenges in identifying the problem statement
- Incubation of proper course relevance.
- Nature of the course.

Problem statement imposes definite limitations and guidelines to carry out the ICP, for example if the course is intended to provide back ground for more advanced courses. It is essential to understand the expectation of those teaching delivery plans. Similarly the course needs to recognize this and incorporate additional features. Once the problem statement have been identified and considered the next step in the design process, namely establishment of learning goals.

Step2: Setting up of learning goals.

Objectives of the course will be well understood by the students when faculty is delivering the course so that they will align the course content to the problem statements. Traditionally a content centered approach is taken: "I want my students to learn about topics A, B and C". Such an approach is easy and simple. It will lead to "understanding and remembering". Present

scenario expects "What could be the impact of this course on students after 2 to 3 years?" As we are adopting paradigm shift from the content centered to integrated course activity where the outcomes are predefined and discussed with the student's prior before delivery of the respective courses. Hence resulting in enhancement of learns ability, team work, soft skill, problem solving skill. This is shown in figure.3 [9].

One important feature of this taxonomy is that each kind of learning is interactive, i.e. each is able to contribute any of the other kinds of learning for example basic knowledge may stimulate critical thinking which intern may stimulate connecting ideas encouraging one to learn about oneself, which intern resulting into getting placed in good profiled company.

To determine the appropriateness and effectiveness project based learning model should consider the following factors:

- Questions on Basic Knowledge skills
- It will deal with information such as facts, terms, formulae, concepts, principles, relationships, etc. are important for students to understand and remember?
- Questions on Problem solving skills
- What kinds of thinking (critical, creative, and practical) are important for students to learn? What skills are required?
- Questions on Integration
- What connections should students recognize and make among ideas within the courses?
- Questions on Goals Related to Resource Utilization
- What should students learn about themselves?
- What should they learn about understanding others and/or interacting with others?
- Questions on soft skills
- What changes/values should students adopt?

Should interests be affected? Commitments?

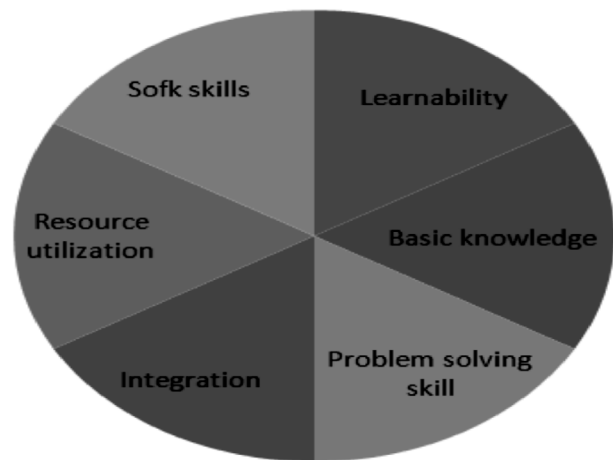


Figure 3: Students Learning skills

Questions on Learnability

- What should students learn about how to be good students in a course like this? How to learn about this specific subject? How to become a self-directed learner (developing a learning agenda and a plan for meeting it)?



Figure 4. Different Phases of ICP

Integrated Course Project activity enhances students learning skills as shown in figure 3, mainly the problem solving, Learnability, peer learning, presentation and communication, efficiently utilize the computing resources and perform performance evaluation

4. Integrated Course Project Assessment(ICP)

The figure 4 depicts the different phases considered for ICP, The assessment is divided into three phases, in the first phase students explore the concept, defining the phenomena in their own words, discussing with other students their experiences and understandings. 2nd phase is realization of studied concepts/techniques to develop project, and apply the concept in new situations or introduce students to

related ideas to explore and gain a deeper understanding of the concept. 3rd phase Implementation and presentation students develop algorithms and code for the same and self assessment will be carried out to analyse and assess what they have learned and how they have learned it, communicating and justifying their explanations[6].

Table 3: Evaluation Parameters and PO, PI Mappings

CIE Component	Evaluation criteria	PO Attainment	PI Attainment	Marks Weight age %
Phase 1	Identify the problem statement, evaluate and propose the methodology	1,2	1.4.1 2.1.2	10
Phase 2	Design and simulate the proposed solution using concepts from CN and OS course	2,3	2.1.2 3.1.4	30
Phase 3	Implementation of system calls, usage of OS utilities and checking QoS issues ,Preparation of report and presentation	2,3,5,10	2.2.3 2.2.4 5.1.2 10.1.1 10.3.1	60

5. Results and Discussions

In the Previous year the course conduction practice was focused on writing exams where students need to just understand the concepts. Most of the students face difficulty in applying the concepts/techniques to develop application. To overcome this problem integrated course project was introduced; this integrated course project activity stimulates the students to understand how the network works, and the concepts from operating system such as the system calls, OS utilities and the network management utilities.

Integrated course project enhances knowledge to combine multiple course concepts to develop a system. Course project will act like a foundation in order to know advance networking concepts such as ad hoc network, sensor network and network management. It also helps in understanding all the 7 layers and the functionalities provided by each of the layer in detail. The problem statements are formulated based on the study of these different layers, where students need to integrate the techniques/concepts to solve the given problem with optimized solution. This approach enables the students to acquire team work, communication and presentation skills to function effectively, both individually and within a team in

their professional careers and engage in lifelong

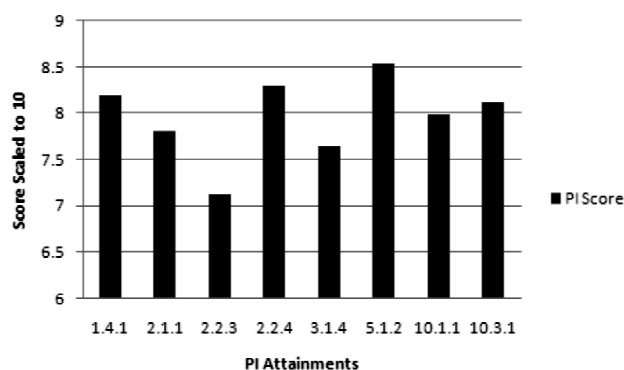


Figure 5. PI outcome Attainment

learning.

PI Attainments

By incorporating integrated course project (ICP) activity in Computer Network and Operating System Courses we were able to address program outcome elements 1, 2, 3, 5, 10. From the figure 5 we can interpret that by conducting ICP activity student's problem solving, analysing and communication skills were enhanced. Even we were able to address outcome elements 3, 5, 10. So teaching this course with ICP will help students to understand the concepts and importantly how to utilize these concepts/techniques to develop applications.

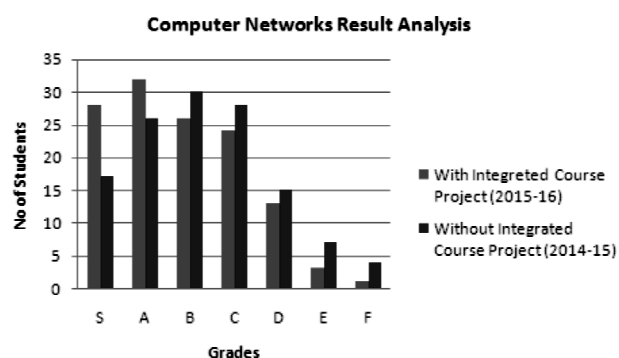


Figure. 5 Computer Networks Result Analysis

The figure 6 shows the computer Network course semester end result analysis. From the graphs we can interpret that students learning has enhanced by doing integrated course project activity, students are able to understand and apply the concepts/techniques studied in class to develop the project. Able to explore different simulation tools and also there communication skills is enhanced.

The figure 6 shows the result analysis of operating system course for the two academic years 2014-15 and 2015-16. From the graph we can interpret that there is shift in grades, students have performed good and learning was effective with the introduction of integrated course project activity, By this approach the students have gained the knowledge of combining two course concepts/techniques to develop the applications

6. Conclusion

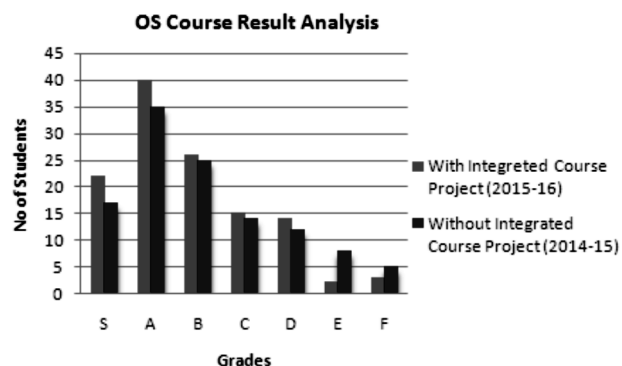


Figure. 6 Operating System course result analysis

The Integrated course project activity has resulted in better performance, through this activity students are exposed to self learning, thinking, problem solving and analysis skills, students were able to correlate the concepts from two different subjects to develop the application. It is a challenging task for course teacher implement a project-based approach and integrate technology into projects in meaningful ways. It is considered as a way of interactive learning were along with the students it benefits all the stakeholders such as industry, community, and college. It provides a framework for experiential and rich learning activities. By integrating courses we were able to address and attain the program outcome element 2, 3,5,10. And the results show that there was major improvement in the grades from A to S and From B to A. In future we aim to effectively integrate the courses to enhance student's learning and help them to perform better in their placement activities.

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