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# Collaborative Activity as a Learning Tool to Improve Students Learning Experience in Core Mechanical Subjects

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## Abstract:

In this world of diminishing resources, renewable energy acts a significant role. The part of the renewableenergy in the future worldis of greatsignificance for the globalenvironmental constancy. Sun, wind and flowing or stored hydro energy are considered the most common renewable energy sources for power generation. The water wheels were progressive in the early ages for the power generation, due to their small contact area and large diameter they were unsuccessful in utilizing water energy successfully, therefore water wheels were less efficient. The kinetic energy available in the open channel water in stream is made use to create the impulse action on turbine blades. Experiment is done by using half and fully immersed turbine blades. The mechanical energy can be changed into electrical energy by the rotation of the turbine. Step-up gear box is used to increase the speed of turbine from lower rpm to higher rpm. A three Phase alternator is used in the project. To extract more energy, turbine blades are made inclined. The result shows that it is possible to generate required output using fully immersed turbine blades.

*Keywords* **— Active learning, flipped classrooms, collaborative activities, analysis, Turbo Machine.**

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## I. INTRODUCTION

Active learning is a method to understand about real time problems and challenges and to solve them using the knowledge gained in a subject during regular class hours. Being active in/out classroom is considered to have a huge impact on the development and learning psychology of the students. However, the activity conditions of the students can be transformed and made stable by enhancing the permanency and efficiency of the learning-teaching process through active learning methods and techniques. In this context, an effective guidance system is critical for producing an appropriate learning behaviour among students. Therefore, the learning-teaching process, which is closely related to process management method, must be effectively employed to achieve this behavioural outcome. In Concrete Experience, the learner encounters an actual experience. This might be a new experience or situation, or a reinterpretation of existing experience in the light of new concepts. InReflective Observation of the New Experience the learner reflects on the new experience in the light of their existing knowledge. In Abstract Conceptualization the reflection gives rise to a new idea, or a modification of an existing abstract concept and in Active Experimentation, the newly created or modified concepts give rise to experimentation. Experiments will give rise to results or solutions which can be used further by the society. Different routes are used to achieve the desired learning outcomes through each of these styles. The learning and teaching process includes

  

subject, object, method, and environmental relations. In this process, these components are intricately interrelated to each other and the whole system. [2].The traditional teaching method begins with the instruction of the teacher, then practice of students. In this approach to teaching, students passively receive information from the professor and internalize it through some form of memorization. This process is characterized as traditional learning. Although traditional learning has been the dominant teaching method, many educators argue that students require more than a mere transfer of knowledge.The search for the best approach to education has led educators to explore many different teaching techniques, ranging from the traditional lecture class to various experimental approaches such as active learning. Teacher's behaviour occupies a dominant position in the whole learning process, which cannot provide students with a chance to active learning and less opportunity to communicate with other students [7].Active learning is a broad concept that is used to refer to educational approaches designed to make students participate rather than passively listen, "anything course-related that all students in a class session are called upon to do other than simply watching, listening and taking notes". To this aim, a single methodology or a combination of techniques may be the best suitable option for a particular course and learning objectives. Flipped teaching approaches are also related to active learning because the passive part of the teaching process is carried out at home and the classroom time is oriented to activities rather than lecturing, sometimes connected by intermediate micro activities related to both classroom and home lessons which is the case of Micro Flipped Teaching [13].

## II. METHODOLOGY

The group active learning needs a proper problem statement and method to solve it. Primary work includes selecting an appropriate method of active learning which is easier and simpler in understanding real time problems. Subjects which more related to real time situations need more experiments or real time applications for the better understanding. It also needs analysis skill of a student. Best suited active learning method for such a case is group or collaborative activity. Collaborative activity has 3 types namely, team assisted individualization, Team game tournament and Student team - achievement division (STAD). STAD Model is selected for this study as it includes students which various level of understanding together for the accomplishment of a problem solution. The five basic key components of STAD are the class presentation, teams, quizzes, individual improvement scores, and team recognition. The Student teams can be made based on their scores in internal exams or based on their participation in such activities, which completely depends on the judgment of the instructor or teacher. Each group or team will be given with a problem statement and a set of dependent variables which will affect either one or more than one dependent variables. The mathematical, technical and general knowledge of the student will be used in solving the problem statement given by the instructor. Instructor has to create a Rubric as an assessment method of each team as well as individual student. Presentation s or Quiz will help in assessing the contribution and understanding level of Individual student. Analysis of data and comparison of results can be done using traditional methods like bar charts, Pie charts, comparison charts etc. Feedback can be collected by the students in understanding the difficulties faced by the students and overall understating of the subject.

## III. THE STUDY

The study includes many steps to be followed and methods to be used. All the steps are explained as follows.

***A. Selection of Problem Statement:***The problem statement was selected from 3$^{rd}$ year, 6$^{th}$ semester Turbo machine subject. This subject is all about understanding the working principle of power

  

plants namely Hydraulic, steam, gas power plant etc. The main objectives of this subject include energy conversion, energy utilization and energy requirements of these power plants or in short energy analysis. A problem statement was selected from steam and hydraulic power plant concept as "Find the overall Power Utilization & efficiency of the plant when it is working under given conditions".

***B. Dependent & Independent Variables:*** Every study need a set or collection of data called as variables. Variables selected for this study are divided intoIndependent & dependent variables. Altogether, there were 25 variables listed out in this study, out of which 22 variables are independent and 3 were dependent variables. Head availability, Storage capacity of the dam or plant, turbine dimensions and losses were selected independent variables and Net power generation and efficiency of the plant were selected as dependent variables.

***C. Sampling & Teams:***Sampling is a method of selecting group of students from a Class (Population). There are different sampling methods available in research methodology. Systematic sampling & judgmental sampling methods are used. Systematic sampling is about systematic selection of student for each group and Judgmental sampling is the selection based on the judgment of the instructor based on his experience of teaching that class. In this study, the students of $6^{th}$ semester of mechanical department are the population and 11 samples or groups are made without excluding any student from the population. 6 students included in each group, such that each group consists of 3 slow learners & 3 fast learners. The assessment method selected is individual presentation which will involve all students and the individual assessment and grading becomes easier. There are no control and experimental groups, as this study is done to understand the knowledge and understanding level of individual student and not to compare with any other students but, can be used to compare between theoretical knowledge analyzed in internal tests and practical knowledge of involving students in solving real time problems using group activities.

***D. Participants & Selection Method:***Participants included 54 students that studied in $6^{th}$ semester of Mechanical engineering, Vivekananda college of engineering & Technology, Puttur. There were 54 boys and 1 girl student and their ages ranged from 22-25 years old. These students are categorized in to slow learners and fast learners based on the Continuous Internal Evaluation (CIE) are done as a part of academic requirements suggested by the university. 1 month time duration was given for the completion of work.

## IV. DATA COLLECTION & ITS PROCESSING

Data collection is involves the utilization of available resources such as internet facility to browse for Power plants which produce electricity and run using hydraulic or steam power, visiting the plants, previously done energy studies, magazines etc. The collected data need to segregated by the students into categories using Nominal, ordinal scale, Interval & ratio scales. The next process involves collection of equations or data hand books which will help in solving and finding the solution.

## V. ASSESSMENT PROCESS

There are many ways to encourage students to collaborate in ways that can be assessed, but most of them can roughly fall into three categories: Group discussions, group projects, and peer review. The assessment which helps in understanding the student's participation and knowledge enrichment can be done either by via Quiz, short answer tests, presentation etc. In this study presentation using poster was selected in order check the participation of individual student.

***A. Rubric Design:***This rubric is designed to evaluate the extent to which undergraduate students participate effectively in collaborative activities and cooperative learning. Rubric design has to be ready at the beginning along with the problem statement and active learning method and to be shared with the student. This tool should be used in relation to

  

structured, recursive processes where 5 to 6 students work together toward a common goal. The rubric design is made based on Likert scale which is a standard classification format for collaborative activities and studies. Quality of knowledge & study, understanding of the student, Involvement, Quantity of data collection and its processing etc can be easily judged by using this rubric design.

TABLE 1
RUBRIC DESIGN

| Criteria | Satisfactory | Good | Excellent |
|---|---|---|---|
| **Marks** | **3** | **5** | **10** |
| **Quality of the Design in A2 Sheet [Report]**<br><br>**Neatness and Orderliness** | 1. Structured Design<br>2. Good Representation | 1. Less structured Design<br>2. Satisfactory Representation | 1. Improper way of Design<br>2. Poor Representation |
| **Cooperation & Team Work** | 1. The presentation contents meets the given contents<br>2. Good & Supporting Reference materials | 1. Only some presentation contents meets the given contents<br>2. Improper supporting reference materials | 1. No presentation contents meets the given contents<br>2. No supporting reference materials |
| **Knowledge & Understanding [Q&A]** | 1. Answer by all the group members<br>2. Good Quality answer | 1. Answer by some group members<br>2. Poor quality answer | 1. No answer by any group members<br>2. Irrelevant answer |
| **Total Marks** | | | |

***B. Group Activity:*** The time duration for the completion of this activity was 1 month. This given duration was must be utilized by the students in collection of data, processing of data, understanding the importance of data collected, use of solving methods such as trial and error until the result is feasible and universally acceptable. The work given is about designing a power plant for maximum utilization of the available energy with maximum possible efficiency and hence, students have to use standard measurements, dimensions and solution methods. A tentative break-up of the time allotted is provided below in table 5.1. The roles and responsibility will be shared with the students by using systematic sampling and judgment sampling. Simple random sampling will create a sampling error as some time students will be able to take up the responsibility and which results in poor activity planning and execution thus, Judgment sampling technique will help us in reducing the sampling error.

TABLE 2
TIME DISTRIBUTION

| Sl No. | Activity | Hours required | Date of Activity |
|---|---|---|---|
| 1. | Collection of Data | 3 Hours | 27/12/2022 |
| 2. | Processing of Data collected | 3 Hours | 30/12/2022 |
| 3. | Selection of equations or Formulae | 3 Hours | 03/01/2023 |
| 4. | Design Calculations and checking the result. | 3 Hours | 07/01/2023 |
| 5. | Trial and Error method to vary the input values in order to get acceptable results | 3 Hours | 10/01/2023 |
| 6. | Poster preparation | 3 Hours | 15/01/2023 |
| 7. | Poster presentation | 4 hours | 20/01/2023 |

***C. Assessment of Collaborative Activity:*** Assessment involves a method which is suitable for the evaluation of the work done by the students. As the assessment was not done in between during the work in progress, only summative assessment tool is used. As we have many assessment methods like presentation, Quiz, short answer tests, Group discussions, 2 minutes discussions etc, the best suited evaluation method for a collaborative activity is presentation where student can able to explain their thoughts, experience, the problems they faced and feasibility of result. In this study Poster and Chalk & Talk Presentation was used. It was instructed to use A2 sheet for the design calculations and for the presentation. Time duration of 10mins was given to students groups for the presentation and 5 minutes were allotted for the discussions followed by the presentation.

***D.Analysis of Data:***Presentation skill & the quality of work and result, Involvement of students etc can be used to assess individual students' contribution and the knowledge gained. The summative assessment data are categorized into two types namely, slow & fast learners. This data was compared slow and fast learners details of

  

continuous internal evaluation (CIE). The table 8.1 shows the comparison between the subject understanding of students when it is analyzed using internal tests and when it is analyzed using collaborative activity and presentation.

TABLE 3
RESULT COMPARISON BETWEEN CIE & GROUP ACTIVITY

| Criteria | Traditional Learning | Active Learning [Collaborative Activity] |
|---|---|---|
| **Slow learners** [≤ 50% of maximum marks] | 16 | 08 |
| **Fast Learners** [> 50% of maximum marks] | 38 | 46 |

## VI. DISCUSSION

In this study, no relation is found between the active teaching technique and Traditional teaching method as both works with different ideology. There has been found a significant difference between the CIE and Collaborative activity result. There has been a significant change in the attitudes of the students in the collaborative activity as it need individual participation and applications of their knowledge. It also includes group discussions and sharing of knowledge. Collaborative activity enhances the learning skills of students and makes them take a decision as they will have a definite role to play in a group activity. A traditional method of teaching and analysis of students understanding ability through internal exams will not be effective until unless students know the applications of it in the real world. The active learning strategies will help a lot in this regard in reducing the gap between the understanding a concept and applying it.

## VII. CONCLUSION

It can be concluded that, the collaborative learning promotes the development of critical thinking through discussion, clarification of ideas and evaluation of others' ideas. The classical teaching and collaborative learning are in most cases, effective in obtaining factual knowledge. Both methods help students in understanding a concept in two different ways. Classical teaching prepares students for the exams and Group activities prepare them for solving a real time problem by enhancing the understanding & memorizing skills.

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