

Imparting Analysis skill in Freshman Engineers - An Experience.

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Abstract: Analysis is an important skill to be developed in engineering students. The Graduate Attribute 2 set in by National Board of Accreditation, India focuses mainly on Analysis. Analysis skills are being developed contextually to a course or field of interest across various universities. In this work effort has been made to understand the effectiveness of learning by teaching general analysis procedure to freshman engineers. Later in subsequent semesters learner can apply the knowledge gained generally on analysis to relevant field of interest. This was achieved by using active learning strategy. Paper bag activity was designed and used as an aid for effective teaching of Analysis procedure. This article describes how Analysis skills are developed in learners by bringing the learners in to the learning context using an active learning strategy and its assessment.

Keywords: Analysis, Freshman Engineers, Active learning

1) Introduction

The meaning of the word Analyse according to Oxford University is "to examine the nature or structure of something, especially by separating it into its parts, in order to understand or explain it". The meaning of the word Analysis according to Oxford University is "Detailed examination of the elements or structure of something". The meanings of these two words are more or less similar even with many other universities even. There are two important things to be observed in the meaning of these words. First, in order to do analysis the breaking of whole into many pieces is essential. Breaking can be referred to as splitting up of a system into its sub components. Second, the analysis is not complete by only breaking the whole into pieces. But a detailed study is to be done on each broken sub component, element or pieces and a study on relationships between each component is to be done.

This two staged process is one important quality which is to be developed in any learner, despite of his course of study. The necessity for analysis for a learner of engineering and technology is a must quality. Because many of the engineering processes demand analysis to be done before solving a problem, while solving the problem, during failure of the problem and also during proper working of the solution. Possibly this is the reason for National Board of Accreditation to state Analysis as a competence to be assessed.

In the work done by Litzinger, Thomas, et al. an effort has been put improve the analysis skills of the learners by introducing context rich, multi-faced problems (Litzinger, Thomas, et al., 2011). Wherein the learner is forced to get into the context and tries to analyse the problem for better understanding, resulting in to a more structured approach of decision making.

The major objective of the work presented in this article was to introduce analysis to freshman engineering students in a generic way than making it contextual to a course of interest, so that the learner learns the analysis procedure in a generic way which subsequently during his further semesters can be applied to any field of interest. The work was a part of the course Engineering Exploration (15ECRP101) for the freshman engineers.

2) Methodology

To achieve the objective of making the learner understand 'Analysis' an active learning strategy was followed. An activity by the name Paper Bag Activity was conducted. As according to the definition of analysis stated above, it consists of two important parts. The challenge faced by the instructors was to come up with some kind of activity which brings the learner into the learning context and motivates him to 'actually do' an analysis activity. In order to solve the above 2 challenges Paper Bag Activity was introduced.

A. Paper Bag Activity

Paper Bag Activity is a simple 3 staged activity through which learner undergoes Designing, Analysis and Redesigning of a paper bag. The details of each stage are mentioned below. This activity was a team activity consisting of 4 members in a team.

B. Designing of Paper Bag

In this first stage of the activity the learner were provided with limited amount of resources, like a sheet of news paper and 5 staple pins. The learner was expected to create a paper carry bag which will carry as many as books as possible. I was clearly mentioned that the bag shall carry king sized 200 pages note books and it shall have a holder. Holder was made a compulsion for the reason that, in majority of the cases the bag failed near the holder. This also helped us to provoke the learner to think about the area of failure. The time given for this activity was 15 minutes.

C. Analysis

Once the bags were designed and made ready they were tested for their capacity. The teams were asked to keep on adding books into the designed carry bag one after the other until the carry bag failed. Intimation was given to note down the maximum number of books carried. This activity was conducted under the supervision of instructors and peers to ensure transparency. After the testing was done the learners were asked to do the analysis of why or how the failure has happened. A structured approach was followed for the analysis procedure to ensure proper learning. The learner was given with a questionnaire which included the details of analysis procedure to be followed. It is to be observed that the questions are in line with the definition of the analysis. The time given for this phase of the activity was 20 minutes. A sample copy of questionnaire filled by a team is shown in figure 1.

D. Redesigning of Paper Bag

After the analysis was done and learner has come up with some inferences about the failure of the bag, he or she was asked to redesign the paper bag but with a constraint that the bag shall now carry 2 more books than the earlier one. After the carry bags were redesigned they were again tested for their capacity. The time given for this phase of the activity was 20 minutes.

3) Observation

Figure 2 and 3 shows the students in action of building the paper carry bag. Since the students are involved in active learning strategy for learning, they were brought into the learning context by this activity very easily. The excitement was maintained high until the completion of the activity. The spirit of competition between the student teams can help us to achieve retention in the excitement. Figure 4 shows the students performing the testing of the designed carry bag.

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Semester/Division: I/ T Sem. C Div	Date: 22/8/16
Course Title: Engineering Exploration	Team Number:

Answer the following

1. Separation of whole into components
Handle, base another covering of the bag.
Main component is the body of bag & others are handle etc.
2. Relationship between components
Bag is the one that which stores the books, and handle one that holds the whole weight.
3. Which is the failure component?
Handle is the main failure component and the rigidity and firmness is a matter of issue.
4. Possible reasons for failure
Weak joints in the handle and joints at the corners are reasons of much the failure.
5. Inference
From this, we get that, we give importance to the structure of the bag handle, by the way of creating with limited resources, to build a strong structure.

Roll.No Sign.

344	[Signature]
362	[Signature]
347	[Signature]
340	[Signature]

Initially it carry 6 books
later it carry 9 books.

Fig. 1 Sample Questionnaire filled by a team.



Fig. 2 Student team busy in designing paper bag.



Fig. 3 Students ready with their designed paper bag.

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Fig. 4 Student team busy in testing the designed paper bag.

In order to assess the students learning 35 samples out of 112 answered questionnaire forms were selected randomly. This particular activity was included as a part of internal assessment for the students. This ensured 100% sincere participation from the students. Hence there was no possibility of erroneous data to be eliminated. The collective data for the questionnaire was recorded and is shown in the figure 5.

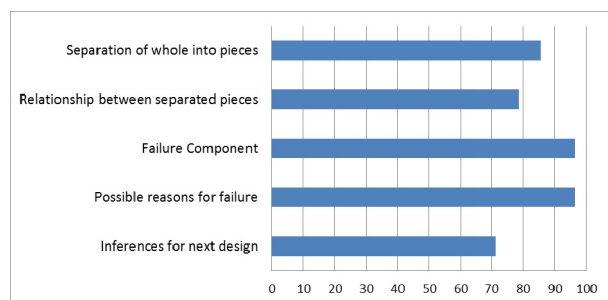


Fig. 5 Collective response of learners for the questionnaire.

The most important step in any analysis activity is to break the whole into pieces or to split the big system into its many sub components. The challenge faced here by any learner here would be the availability of many ways of breaking the whole into pieces. The splitting up of the system into sub components may have multiple approaches based on the perception of the learner. And coming to the conclusion of which procedure is best is a challenge. In this work it is observed that 85.71 % of the learners were able to successfully separate out the whole into pieces. It should be noted that the focus was not given on how the breaking is done.

After splitting up the entire into pieces, next is to study in detail each component and try to understand the relationship between each piece. In current work, since the whole system was the entire carry bag, after splitting into its sub components, there is no point in detailed study of each sub components. Because, the sub components are all simple pieces of paper. Hence the learners were directly asked to study the relationship between each sub

components of the system. In this work it is observed that 78.57 % of the learners were able to successfully establish some valid feasible relationship with in each sub components.

In this work the next question asked was regarding identification of failure component. It is observed the learners did well with 96.42 % because, in majority of the cases the failure component was directly visible.

The next question was on possible reasons for failure. This question was slightly trickier. One should note that the experiment was conducted on freshman students who do not have or have minimal amount of engineering knowledge. The answers given by them were vague, but may be close to actual. It was the role of the instructors to help them out to come with proper answers. It is observed that 96.42 % of the learners successfully came up with some possible reasons for failure with the help of instructors.

The last question was on inferences to be drawn for the redesign of the bag. It is observed that 71.42 % of the learners successfully came up with some inferences to redesign their carry bags with better capacity. This question had the least score. This is learning for the authors which is being worked upon in the subsequent experimentation. The score is a direct indication of learners not being capable of drawing out some inferences out the activity and need some kind of instructor help.

Below are some other observations made:

- 1) Getting the students into the learning context is very important in any of the teaching learning process. The active learning based models will be the most suitable solutions in this regard. Since paper bag activity was a team activity and learning happened through active learning strategy, students were naturally brought into the context.
- 2) The activity involved designing of a new thing, which invariably needs the learner to start design thinking. The learners were forced to follow the design process for making ready the carry bag.
- 3) The kind of the analysis done in this activity was failure analysis. The kind of learning students had after analysis and redesigning was phenomenal. Initially students ended up carrying only 6 or 7 books, but, after redesigning the bags carried 17 or 18 books, which is significantly large than the initial value. This was visible proof for the fact that we all learn by experience. Failure is just a stepping stone towards success.
- 4) The feedback taken in the form of focussed group discussion after the completion of the semester revealed that the paper bag activity was one of the most liked activity by the students.

4) Conclusion

Imparting analysis skills into the engineering students is a most important part of curricula. Through the experiment conducted 71.42% of success rate was achieved. It means, 71.42% of the learners were able to do the analysis process satisfactorily.

It should be noted that in this work general analysis procedure is learnt. This generic procedure can be later applied to the chosen field or course of interest by the student. Learning the generic analysis procedure can be considered as a foundation for further semesters of engineering. The curricula of higher semesters can be modified accordingly to best address the gap between freshman and higher years of engineering.

Paper bag activity was one of the most enjoyed activities by the students. This activity is a mixture of design and analysis, which can give students a better insight about the necessity of analysis in design process. The resources needed for the activity is also not finance intensive. But the learning achieved by the activity is worth.

Paper bag activity along with suitable guidance to learners can be considered as an effective way of developing analysis skills in learners.

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