

Open Ended Quizzes - A Strategy to Enhance Critical Thinking of Student in Engineering Education

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Abstract: During the traditional teaching instructor use the quiz, such as multiple choice questions or peer instructions, in which while attempting the quiz students' memorize questions, answers and formulae. With this, students will not get depth knowledge of the concept and will not be able to solve similar kind of problems. We used Open-ended quiz strategy (Madison (1995)) followed by traditional teaching. The open-ended quiz proposed to motivate students' creativity and to guide students to think deeply about the material covered in lectures. The goal of our presented work is to make students think genuinely about the concept. This will assist students to solve problems that do not specify all the information that is needed to arrive at the answer. We have implemented open-ended quiz for Second Year students of Electronics engineering while teaching Analog Communication course. This method helped students to gain conceptual knowledge and increases problem solving and analysing ability.

Keywords: Open-ended quiz, Analog communication, active learning, effective teaching, outcome based education.

1. Introduction

Now-a-days OBE i.e. outcome based education had most integral and innovative future trend in engineering education which requires thorough assessment and evaluation of the students individually, with special focus on the overall development of the students. Most important, to be actively involved, students must engage in such higher-order thinking tasks as analysis, synthesis, and evaluation. Within this context, it is proposed that strategies promoting active learning be defined as instructional activities involving students in doing things and thinking about what they are doing.

Our goal as an engineering instructor is not just making a student literate but adds rationale thinking, knowledge ability and self sufficiency. Basically teaching must include two major components sending and receiving information. Ultimately, a teacher tries his best to impart knowledge as the way he/she understood it. So, any communication methods that serve this purpose without destroying the objective could be considered as innovative methods of teaching. The use of innovative methods in educational institutions has the potential not only to improve education, but also to empower people, strengthen governance and galvanize the effort to achieve the human development goal for the country. Creativity can be developed and the innovation benefits both students and teachers.

The open-ended quiz (Madison, (1995)) is intended to stimulate students' creativity and to help

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students to think deeply about the material covered in lectures. In contrast, straightforward “Given this, calculate that” or “Plug and chug” type of quizzes merely encourage students to memorize equations and formulae. Open-ended quiz strategy makes innovation in educational practice that can improve students' learning and faculty productivity. This method engages the entire class, motivate students and promote higher-level thinking. It helps students to think individually about a topic, share ideas with classmates, builds oral communication skills focus attention and engage students in understanding the reading material.

Open-ended quiz strategy is useful for mathematical based courses like Analog Communication, Digital Communication and Electromagnetic engineering, etc. where concept of theory is followed by related numerical problem statement.

2. Related Work

In this section different teaching methods are discussed which are implemented for mathematical based courses.

In Traditional Teaching Method – An evaluation, the teacher controls the instructional process, the content is delivered to the entire class and the teacher tends to emphasize factual knowledge. In other words, the teacher delivers the lecture content and the students listen to the lecture. Thus, the learning mode tends to be passive and the learners play little part in their learning process. It has been found in most universities by many teachers and students that the conventional lecture approach in classroom is of limited effectiveness in both teaching and learning. In such lecture, students assume a purely passive role and their concentration fades off after 15-20 minutes (Damodharan V. S. et al.).

Draper S.W explained Open ended observation (OEO) in evaluation as opposed to fixed quizzes and questionnaires. In this method, instead of asking fixed question they have provided case study related to concept in which students will notice that what have done enough or issues in each given cases (Draper S.).

Boulmalf et al. provided an efficient and effective method for teaching digital and analog modulation to undergraduate students enrolled in an Information Technology program which does not require a strong

foundation in mathematics as in the case of an Engineering program. The method used here utilizes Matlab packages, Simulink, and Communication Block set to simulate analog and digital modulation techniques avoiding the derivation of any mathematics formulations and without coding. Here, a survey conducted showed a high level of satisfaction in understanding all modulation concepts (Boulmalf et al.).

3. Methodology

The research question was

“How effective teaching strategy will help to improve students' creativity and critical thinking on the content topic?”

Memorizing the topic content will not help student to improve their technical knowledge in the field of communication engineering. Thus, a solution is to be found so as to help students to think deeply about the course material taught in the lectures. This can be achieved with the implementation of open-ended quiz strategy.

A. Open-ended Quiz Strategy:

The open-ended quiz is intended to simulate students' creativity and improve students' critical thinking on the topic taught in the class (Madison, (1995)). The goal is improving students' critical thinking in the duration of 10-15 minutes with the help of open-ended quiz strategy which is explained here.

In this strategy, problem statements will be provided to the students. During the problem solving, the following guidelines will be given by the instructor that student should

- i) Find critical information necessary from given problem statement.
- ii) Remove unnecessary information from problem statement.
- iii) Find different ways to solve the problem.
- iv) Decide the best solution to solve given problem statement.
- v) Also, come up with different analogies to easily understand the given problem statement.

The following template can be used to gather the above information related to the given problem

statement but it is not necessary that the students should strict with this template. There is enough space need to be given to the students to think critically on the solution and data required to solve the given problem statement.

Table 1: Template for Open Ended Quiz Method

Problem Statement: -----			
Critical Information	CI1	CI2	CI3
Different Ways to Solve	M1	M2	M3
Unnecessary Information	UI1	UI2	UI3
Parameters to decide best solution	P1	P2	P3

The guidelines provided in the open-ended quiz strategy encourage students' to think about the required information to solve the problem as well as the different possible ways relate to the concept and the formulae taught during the class. In this strategy, students are asked to solve the problem that may follow in one of the following categories

1. A problem which has more information than what is needed to solve the problem. The students must now think about what pieces of information are critical to solving the problem at hand.
2. A problem which has less information than what is needed to solve the problem. The students must now think about what pieces of information are missing to solving the problem at hand.
3. A problem that has the students come up with a list of different ways to accomplish a specific task. The discussion of the feasibility of various methods will help students acquire the ability to critically evaluate different solutions.

For example, students can be asked to solve the problems that do not specify all the information that is needed to arrive at the answer. The students are then forced to think about what other information may be needed, and how they might go about obtaining the needed information. This strategy will move students away from memorization.

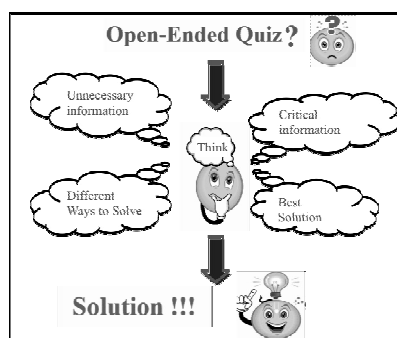


Figure-1: Basic Flow of Open-Ended Quiz Strategy

B. Experiment Setup:

The open-ended quiz strategy is implemented for Second Year Engineering students of Electronics department with strength of 61 students. To measure the effect of this strategy, the experiment is conducted in two methods.

Method-I: Traditional Teaching

Method-II: Traditional Teaching followed by Open-ended quiz

The above methods are implemented in classroom session. In method-I regular teaching is done and then test conducted. In method-II, after lecture one or two questions are written on the board. As per the guidelines, students have to think and realize insufficient data, irrelevant data and steps to get the solution. To increase maximum involvement of students, points ranging from 0 to 10 were allotted. Three to four such sessions are conducted for 15-20 minutes. A test of 25 marks is conducted to evaluate student's performance after conducting above mentioned sessions.

Consider, the above two methods implemented for the topic "Analog Modulation" from the course Analog Communication.

Example-1 : For Problem Based Questions

For Method-I, question asked based on Analog Modulation topic is as given below:

Q.1.1) An antenna transmits an AM signal having a total power content of 15 kW. Determine the power being transmitted at the carrier frequency and at each of the sidebands when the percent modulation is 85%.

After teaching the concept of modulation index for amplitude modulation then the above question is asked. To solve this problem student will use the given formula to solve the problem. In this case, students memorize the problem and the solution.

For Method-II, the following question is used for open-ended quiz implementation on the same topic "Analog Modulation"

Q. 1.2) An AM signal has a carrier power of 5 W. The depth of modulation is 80%. What should be the modulation index to get approximate 50% decrease in

total sideband power.

The question number 1.2 is based on the same concept. The above Q.1.2 is constructed by instructor in such a way that while solving this problem students' will think about

- What pieces of information are critical to solve the problem at hand?
- They will come up with a list of different ways to accomplish a specific task.
- The discussion of the feasibility of various methods will help students acquire the ability to critically evaluate different solutions.

Example-2: For Theoretical Questions

For Method-I, question asked based on Analog Modulation topic is as given below:

Q2.1) Justify the statement – baseband signal cannot be transmitted directly through space.

For Method-II, the following question is asked

Q.2.2) Is modulation significant part of communication system? Is it required for baseband transmission or bandpass transmission or both and why?

The answer for both the questions, (Q.2.1 and Q.2.2), is same by theoretical point of view. While attempting Q.2.2, student will come up with different analogies to easily understand the concept and arise to the answer in the modular way.

This strategy aims at moving students away from memorization. Students can be asked to solve problems that do not specify all the information that is needed to get answer. Students have to think about what other information may be needed and how they might go about obtaining the needed information. Students can be asked to come up with creative questions.

4. Experiment Result and Feedback

As explained in the experiment setup, tests are conducted after Method-I and Method-II implementation. The effect of open-ended quiz strategy is assessed based on the scores in these test.

Here, the test conducted after Method-I is called as Pre-Test and the test conducted after Method-II is called as Post-Test.

As shown in Fig-2 the number of students scoring above 60% is increased due to practicing open ended quiz activity. Average of pre-test score is 42.36 and average of post-test score is 52.92

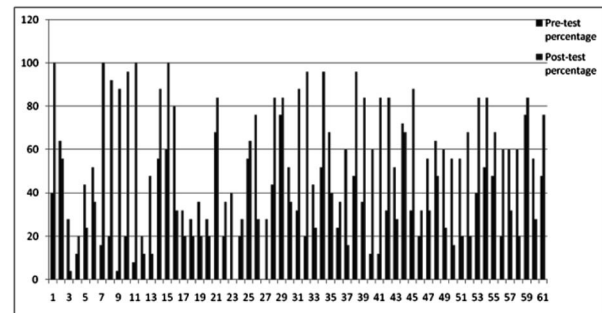


Figure-2: Pre-Test and Post-Test Results

In Method-II, solved problems are assessed based on the information obtained. Each question graded from 0 to 10 points. Creative questions framed by students are assessed based on the level of creativity. It must not be straight forward like 'Given this, calculate that' type of questions.

Students' Feedback

To know the students' opinion, about the open-ended quiz activity conducted, a survey instrument Likert-Scale is used here to collect students' feedback. The students' feedback about open-ended quiz strategy is shown in Table-1:

Table-1 : Student's Feedback about Open-ended Quiz Strategy

Sr#	Questions		Agree	Neutral	Disagree	Strongly Disagree
Q.1	Conducting open ended quiz sessions in class are interesting	36%	60%	4%	0%	0%
Q.2	I gained clear understanding of the concepts studied	43%	56%	1%	0%	0%
Q.3	Solving for steps of solution of problem needs thinking and rethinking	29%	70%	1%	0%	0%
Q.4	I can now create my own questions on the topic studied	38%	60%	2%	0%	0%

5. Conclusions

This strategy aims at moving students away from memorization. Students can be asked to solve

problems that do not specify all the information that is needed to get answer. Students have to think about what other information may be needed and how they might go about obtaining the needed information. Students can be asked to come up with creative questions. Students' performance in pres-test post-test showed that open-end quiz strategy had improved their problem solving and critical thinking skill.

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