

RUBRIC BASED ASSESSMENT OF MODEL MAKING: AN OUTCOME BASED APPROACH

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Abstract

The aim of this paper is to incorporate a new method in assessing the knowledge gained by the student, rather than an exam following the traditional methods of assessing. An instructor has many strategies in fulfilling the course by meeting the course learning outcomes (CLO) and mapping them with the program outcomes (PO). Courses designed and the culture of educating students is to be framed in such a way that it is measurable and have the outcomes from it as outcome-based education (OBE). This paper focuses mainly on conducting the exam through model making and assessing the graduate students of mechanical engineering at RK UNIVERSITY, Rajkot. Model making is a unique approach which enhances student's critical thinking and deep understanding, including series of steps skilled questioning, effective interaction and teamwork. Conducting such kind of exam made students to recall the knowledge, working principle, proper selection of tools, appropriate usage of machines (if required) in transforming the material to a model from the courses where they had undergone in the earlier semesters which maps with blooms taxonomy. Furthermore, a detailed reflection of students is carried out by conducting survey and analysis had been presented.

Keywords: Course learning outcomes (CLO), program outcomes (PO), blooms taxonomy, outcome-based education (OBE)

Introduction

Today's engineers are tomorrow's creator, from this saying it is clearly understood that a student on getting into field must serve the society. He/she plays a major role in bringing changes and development of the existing products and makes the life simpler. The industrial revolution had paved the way for globalization where the world and necessities are getting upgraded very fast. Here the role of an engineer becomes very critical and is forced to do necessary manipulations and get updated. In an organization, a group of engineers undergo brainstorming and work together irrespective of their expertise field. Considering all the points discussed above an engineer must be molded in such a way, where he/she is capable enough to understand the situation, problem-solving skill, developing new system, critical thinking such skills must have been inculcated by the student at college/university

level environment where the role of an instructor and their influence is more. A student can be molded accordingly if the course curriculum is designed accordingly, instructors having a goal in driving the students towards the outcomes of the course as expected according to them. It is, therefore, necessary to have CLO's for the course designed by the instructor. Knowledge gained by the student must be measured by conducting qualitative assessment techniques.

Outcome-based education (OBE)

OBE clearly highlights the learning outcomes as where a student must possess hands-on experience and capable enough to demonstrate the system at the time of graduation, which is certainly not happening in certain education systems due to their limitations, for example in a laboratory session where there are half a dozen of machines, only the purpose and the operations performed on the machine shall be discussed. Removing the casing and showing the internal parts with their functioning is not being taught and students are habituated to this system for same throughout their program which is causing a lack in their technical stuff, leaving them as half knowledge. This shall cause a harm to the graduates in coming years. OBE promotes in pedagogical methods in teaching and measuring the knowledge gained Ralph W. Tyler⁶. From the literature survey done it was observed the practice of implementing outcome-based education had started in many of the foreign countries by an eminent highly qualified professor from the schooling level to the higher-grade school. As the proposal was optioned to carry out the teaching process through OBE there were many criticisms, which stated that the existing traditional method is more useful than OBE. During 1990s Dr. Spady¹ stated that the education system is totally outdated and not going to serve the society in coming years where a student shall face many challenges once he/she is on the field. By examining the education system, he felt two things are very crucial.

1. The future of the school children.
2. The culture of the education system where the students are being brought up.

He clearly had stated that the current education system is totally outdated in the mid-90s which shall challenge the students.

Conferring to Acharya² referring to OBE and expressed his views, as an instructor/ course coordinator on designing the course what are your expectations that a student will learn? On designing a course how can you measure the knowledge gained by the student. To meet the required expectations, designing the curriculum and the methodology adopted in conducting the classes must be designed in a different way. The methodology adopted makes students to think out of the box.

Course based outcomes

A course offered must have the desired outcomes from being taught in such way that a student is capable enough to develop and demonstrate his/her work according to the required outcomes. OBE has a clear picture which showcases the standards of the student which is measurable. As an instructor/ course coordinator, have certain benchmarks that are expected from the students on the completion of the course which is achievable by teaching methodology implemented, conducting the classes in a manner of engaging students in active learning in the class within or away from classrooms, designing the experiments related the course, designing the assignments individually and many more can be into account for measuring the knowledge and the skill gained by the student. It is much necessary for mentioning the objectives of the respective class for the respective topic by a faculty by mentioning what is the purpose of learning today's topic? Why should I learn this? How is it going to benefit me? What will I be doing by learning the topic? This shall promote in identifying the CLO's for any course being offered to any degree program. Critical thinking as mentioned shall play a key role in the industry where several multinational companies are looking for the approach being adopted by a graduate in comparison with many other educational system standards. Many foreign universities had focused in defining the student learning outcomes and implemented for the courses being offered and had set a benchmark in implementing outcome-based education. Parallely they are compared with the ABET criteria and frame the CLO's in meeting the requirements Dr. Muhammad H Rashid⁴. As mentioned in the paper designing the course, setting the benchmark, conducting the session, use of appropriate tools in measuring the knowledge gained through quality assignments and its evaluation shall strive towards OBE. Conduction of the lecture sessions must be done where students shall participate in discussion rather than being a continuous recipient by following few methodologies like think pair and write, think and write, dividing the class into a number of small groups and reflecting the knowledge gained from the session as a part of active learning. Some of the techniques highlighted shall develop critical thinking among the students. Students must be an active participant in the class rather than getting adapted to traditional learning Etienne Wenger⁵.

Methodology

RK University believes in outcome-based education where the student should not mug up the content from the textbook, material provided by various web sources etc.

They need to apply the knowledge gained during study and faculties are trained enough in delivering their lectures by active learning and engaging the class by giving them various tasks. As a state private university, freedom is given to instructors in conducting the exam in a measurable manner by applying for AAC (Assessment Advisory Council). Within the university limits, the committee is framed by the management of RKU, where an instructor concerned to his/her course needs to apply for AAC, which shall be scrutinized from the departmental level to director level and finally by the management. By considering the CLO (course learning outcomes) and PO (program outcomes) the selected mode in conducting the exam an instructor shall undergo for peer review following the sequence as mentioned above. The applicant may undergo for necessary modification in satisfying the comments given by the peers (instructors related to the specialization). Depending on the way in conducting the mode of the exam and satisfying the course requirements the application may get approved, or get rejected at departmental, director or management. This paper represents assessing and mapping the system to CLO's of the course, where it has got approval from AAC for model making to the course Kinematics of Machines offered in Mechanical department for fourth semester students during the academic term of 2016-17 for a strength of approximately 120 students, which was assessed as part of practical examination where students were intimated about the mechanism preparation as model making at the beginning of the semester. Assessment methodology and guidelines were provided to the students, which made them to think out of the box and had regular discussion with the instructor. CLO's for the subject is as follows.

CLO's for Kinematics of Machines

1. **Describe** the concept of machines, mechanisms and related terminologies.
2. **Recognize** friction and its effect in mechanical components.
3. **Analyse** planar mechanism for displacement, velocity and acceleration graphically.
4. **Analyse** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive.
5. **Utilize** analytical, mathematical and graphical aspects of kinematics of machines for effective design.
6. **Perform** the kinematic analysis of a given mechanism.

Assessment on OBE

As mentioned in the paper and from the observations literature survey done OBE is what is taught is what students learn and shall reflect the same. The method followed in assessment also lies in the implementation of the OBE for any course or any degree. Assessment done shall be based on the outcomes of the course where an individual attention is to be followed and no comparison or criticism done. According to Byrne and Flood³ some may

achieve as per the standards whereas some may not. For the above-mentioned methodology, a rubric was prepared by the faculty mapping the CLO's and PO's which is highlighted in the following tables 1, 2 and 3, where the same had undergone few changes after several brainstorming sessions from the department to the management level as mentioned in the table.

Results and discussion

From this paper we share, the pedagogical approach which can be considered as one of the approaches in driving towards the OBE. We had assessed the models and

followed a different approach in conducting the exam which had translated from the learning to practice in implementing it from various domains (machining, assembling, selection etc.) to strive towards OBE. A final presentation was conducted where students represented their work and demonstrated the model (mechanisms). As mentioned the following rubric table:1 was followed in assessment in brackets the number represents the marks gained on the level of performance.

Table: 1 Rubric for the model making

Criteria	Excellent (10)	Good (8)	Average (6)	Needs Improvement (4)
Visual appearance	Apt choosing of colors. Dimensions considered are mapped after preparing a model.	Right selection of colors. Almost close to the required dimensions.	Selection of not attractive colors. Not much clear with the basic requirement.	No proper selection. Lacking in pre-requisite knowledge.
Selection of materials	Appropriate in choosing the materials. Utilizing the resources effectively.	Right selection of material. Following the advices from the instructor.	Not clear with the materials. Lack of communication among the team members.	No idea about materials. Lack of communication among the team members.
Team work	Giving respect to the ideas of the team mates and had effective brain storming sessions.	Few persons are very active in the problem-solving skills.	Very few participants are active among the group members.	No participation and lacking seriousness.
Originality/ Technicality	Right selection of materials, machinery. Visualizing the efforts and correct movement in the mechanism.	The model is often as per the requirements. Few members are active from the group.	Occasionally using right materials. Few parts are assembled which are available in the market.	Components are not meeting the expectations and are assembled by third party.
Presentation	Content of the model thoroughly covers the learning goal. Informative presentation. Discloses the quality of work.	Clear with the content few members having knowledge about the concept.	Content of the model covers only few learning outcomes. Not very clear About the concept and the model.	Presentation not up to the mark. Violating the deadlines. No information regarding the progress.

The task was performed by a group of 4 students which totally comprised of 35 groups, each and every student was assessed fairly and were given marks based on the rubric generated. Sample figures 1 and 2 displays the models prepared by the students.



Fig: 1



Fig: 2

Fig: 1 and 2 showcases the model making of two different groups.

Table: 2 List of PO's for Kinematics of Machines

PO 1	An ability to apply knowledge of computing, mathematics, science, and engineering
PO 2	An ability to design and conduct experiments, as well as to analyze and interpret data
PO 3	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
PO 4	An ability to work effectively in Team (may be multi-disciplinary teams)
PO 5	An ability to identify, formulate, and solve engineering problems
PO 6	An understanding of professional and ethical responsibility and social issues.
PO 7	An ability to communicate effectively.
PO 8	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context
PO 9	A recognition of the need for, and an ability to engage in life-long learning and continuing professional development
PO 10	Understanding of contemporary and emerging technology systems.
PO 11	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
PO 12	Will demonstrate an ability to participate and succeed in competitive examinations related to higher education and employment.

Mapping CLO's with PO's

Table: 3 Mapping CLO's with PO's

PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
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CLO1	CLO 2	CLO 3		CLO 5	CLO 3		CLO 5	CLO 4		CLO 4	
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Conclusion

From the assessment technique and the examination conducted it was observed that they had effectively utilized various resources, continuous interaction with instructor and the points discussed guided them in understanding and presenting the concept of the subject which clearly states in achieving the learning outcomes. As an instructor and from the literature survey done and my experience I strongly believe that the OBE can be achieved if the practice of implementation starts from schooling. A student on reaching higher standards in education must be capable enough to think out of the box, where schooling acts as a pre-requisite knowledge about the course being studied. Critical thinking dimension plays a crucial role in the student in the application of the knowledge gained. However, in India, since the education culture is different from foreign universities where there are different schooling boards, both parents and teachers apply the wrong concept in comparing the score or percentages gained by their wards with either the relatives, neighbours or anybody else. If the OBE process gets implemented in the schooling level the sort of thinking ability, reframing or restructuring, development of prototypes, minor projects etc. which can be a solution to the existing systems and make our work simpler, such type of mind set up can be aligned with the same concept of OBE in the higher-level education which can create wonders and change the fate of world. Hoping for the same point to happen in the future and modify the current education system as a single platform of OBE.

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