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Use of assignment mode for effective assessment of students to achieve course outcomes

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Abstract—To ensure the quality learning of students, course outcome assessment is vital element of outcome based education. To achieve course outcomes, various modes of pedagogy and assessment are essential. There are different modes of assessment for In-semester examination like multiple choice questions, time bound pen and paper, presentations, seminars, assignment etc. This paper explains the use of assignment mode for effective assessment of students. This paper highlights how assignment mode helps students to apply concepts taught in classroom to solve various problems on applications of engineering mathematics. We had done assessment of 610+ F. Y. B. Tech students by giving different assignment to each student which included different set of questions for the course Linear Algebra and Univariate Calculus with time bound submission. This ensured that students have to solve the assignment independently without taking help of peers. This paper describes how assignment mode has improved various competencies of students. This paper is illustrated with responses of F. Y. B. Tech students. The proposed method is useful for online and offline mode of examinations.

Keywords—Assessment, Assignment mode, course outcomes, Mathematics, Students' responses

I. INTRODUCTION

To achieve course outcomes, different types of teaching and assessment methods are used in Outcome Based Education (OBE). Conventional assessment methods test memorized learning ability of student, which is less useful in view of OBE. It has become more challenging to assess students through conventional assessment methods.

In educational institutions, there are different views of assessment element for different course instructors for the same course. Classroom assessment serves as a process of gathering and interpreting evidence to identify student's progress in order to make decisions about forthcoming actions in day-to-day teaching [1,2,3].

Mode of assessment in a course plays an important role in students learning. Most of the universities have implemented outcome based education, in which assessing course outcomes is crucial. Many a times, examinations are time bound pen and paper. There are limitations on paper setters for setting question paper. Students should be able to apply the knowledge of classroom teaching to solve application based problems independently. In pen and paper examination, same question paper is given to all the students, hence students sometimes try to imitate each other's answer irrespective of whether the answer is correct or not. In this way, course instructor is unable to judge problem solving skill of students. To

overcome these drawbacks, we shifted to assignment mode in more effective way.

II. LITERATURE REVIEW

In OBE, a "design down" process is employed which moves from Program Outcomes (POs) to Course Outcomes (COs) and outcomes for individual learning experiences [4]. Different assessment methods are used to measure the gain of learning goals. Some of them discussed in [5] are multiple choice questions (MCQ), descriptive answers, essays, practical case, problems, reflective practice with its relation to knowledge and cognitive dimensions. The authors [6] suggest some of the methods to be included in the implementation of outcomes-based assessment and the issues to be considered in the actual implementation.

In [7] author has presented different assessment ideas currently used in higher education. Also, author has proposed that there must be difference made between assessment tasks are intended to influence current and future learning, which helps to develop self-motivated and life-long learners. In [5] author has proposed a model which line ups assessment strategies based on e-learning.

Defining apt course outcomes and their mapping to generic program outcomes and program specific outcomes (PSOs) is crucial in implementing Outcome Based Education philosophy [8-14]. Generic program outcomes have to map with graduate attributes defined through Washington Accord and do not offer any flexibility in redefining except rewording [15-18].

III. METHODOLOGY

1. Evaluation systems

In-semester examinations: This is a regular assessment conducted in the semester to evaluate learning periodically. This supports course instructors to know that the learning happened and can take any corrective steps if required to improve the learning.

The In-semester examination (T1 & T2) can be conducted in different modes such as quiz, orals, presentations, open book examination etc. In-semester examination is a very good practice, as students get prepared for end semester examination and course instructors can make sure that students achieve course outcomes. End semester examinations (ESE): This examination is conducted at the end of the semester. We cannot make any corrective measures for that batch of students. Nevertheless, we can include changes in our teaching for the next batch of students.

2. Assignment mode

There are different ways in which assignment mode can be used for assessment. Usually, course instructors give same set of questions as an assignment to all the students. In that

method of assessment through assignment, the main drawback is that very few students solve the assignment independently, while major of the students tend to imitate other student's assignment and just submit. The main motive of using assignment mode is to make student think independently which is not achieved through this way.

To overcome this, we have designed different set of question paper to each student i.e. no two students will have same question paper. Since each student got different assignment to solve, each student has to understand the theory first and secondly learn how to apply mathematical concepts to application problems.

As the examination was through online mode, we created Google classroom for all the branches and enrolled respective students in it. We assigned different question paper to each student through Google classroom with time-bound submission. While deciding time for solving the assignment we have taken care that student will not get time to discuss with each other and can complete paper on time.

Before assigning the questions to students, we have informed students about this new mode of examination i.e. different question papers which they are going to get, so students were more prepared to solve the questions independently.

Sample questions are given in the following Table1, Table2, and Table 3.

Table 1: Sample Question No 1

1	Given Cipher text: BUWRGMSRPQXQEYZHMY Two matrices given : a) $(-9\ 4\ 4\ -8\ 3\ 4\ -16\ 8\ 7)$, b) $(2\ 2\ 0\ 2\ 2\ 0\ 0\ 0\ 1)$ Use suitable matrix from above data to decipher the given statement. Justify your choice of matrix.
2	Given Cipher text: AIGAOBFYIVGJMTWHMY Two matrices given : a) $(4\ 0\ 1\ -2\ 1\ 0\ -2\ 0\ 1)$, b) $(-9\ 4\ 4\ -8\ 3\ 4\ -16\ 8\ 7)$ Use suitable matrix from above data to decipher the given statement. Justify your choice of matrix.
3	Given Cipher text: WGWLVSFAFSIVQSMGDZYEI Two matrices given : a) $(-9\ 4\ 4\ -8\ 3\ 4\ -16\ 8\ 7)$, b) $(4\ 2\ -2\ -5\ 3\ 2\ -2\ 4\ 1)$ Use suitable matrix from above data to decipher the given statement. Justify your choice of matrix.

4	Given Cipher text: RDOSCEMJIUGBIUTFYEI Two matrices given : a) $(2\ -1\ 1\ 1\ 2\ -1\ 1\ -1\ 2)$ b) $(-9\ 4\ 4\ -8\ 3\ 4\ -16\ 8\ 7)$ Use suitable matrix from above data to decipher the given statement. Justify your choice of matrix.
5	Given Cipher text: WGWTAHMORQMSWXQSEAPZI Two matrices given : a) $(-9\ 4\ 4\ -8\ 3\ 4\ -16\ 8\ 7)$, b) $(-9\ 2\ 6\ 5\ 0\ -3\ -16\ 4\ 11)$ Use suitable matrix from above data to decipher the given statement. Justify your choice of matrix.

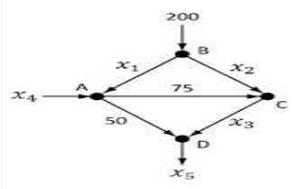
In Table 1 above we can see that question allotted to each student is different.

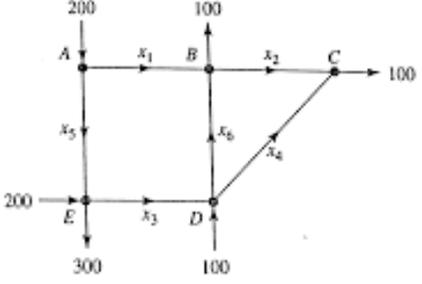
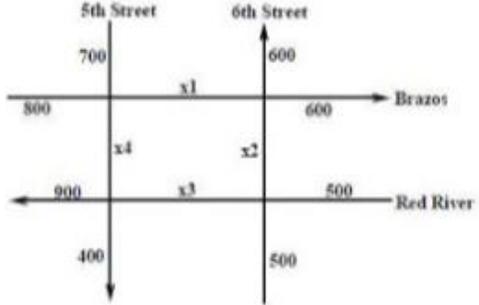
Table 2: Sample Question No 2

1	Given a matrix $(4\ 2\ -2\ -5\ 3\ 2\ -2\ 4\ 1)$. i) Find the characteristic equation. ii) find Eigen values.
2	Given a matrix $(4\ 6\ 6\ 1\ 3\ 2\ -1\ -4\ -3)$ i) Find the characteristic equation. ii) find Eigen values.
3	Given a matrix $(1\ 0\ -1\ 1\ 2\ 1\ 2\ 2\ 3)$ i) Find the characteristic equation. ii) find Eigen values.
4	Given a matrix $(1\ -1\ 0\ 1\ 2\ 1\ -2\ 1\ -1)$. i) Find the characteristic equation. ii) find Eigen values.
5	Given a matrix $(1\ -1\ 0\ 1\ 2\ 1\ -2\ 1\ -1)$. i) Find the characteristic equation. ii) find Eigen values.

In Table 2 above we can see that questions are based on same topic but the problems are different.

Table 3: Sample Question No 3

1	Apply the knowledge of matrix algebra to solve following traffic flow problem Solve the system for the unknown flow rates 
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2	Apply the knowledge of matrix algebra to balance the following chemical equation $CaCl_2 + AgNO_3 \rightarrow Ca(NO_3)_2 + AgCl$
3	Apply the knowledge of matrix algebra to solve following traffic flow problem Solve the system for the unknown flow rates. 
4	Apply the knowledge of matrix algebra to balance the following chemical equation $Pb + H_2O + O_2 \rightarrow Pb(OH)_2$
5	Apply the knowledge of matrix algebra to solve following traffic flow problem Solve the system for the unknown flow rates. 

In Table 3 above we can see that student has to model the problem mathematically and then use Linear algebra to solve it.

IV. RESULT

(A) Result Analysis

While correcting the papers, it is observed that imitating each other's answers among students was totally eliminated as there is no common question. Improvement in the result and understanding of topics was observed.

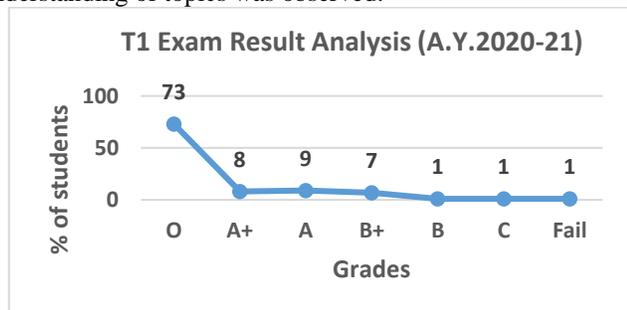


Fig 1 Assignment mode

Fig 1 shows result analysis of T1 exam through assignment mode in A.Y 2020-21

- 73 % students scored Outstanding grade
- 8 % students scored A+ grade
- 9 % students scored A grade
- 7 % students scored B+ grade
- 1 % students scored B grade
- 1 % students scored C grade
- 1% students were failed

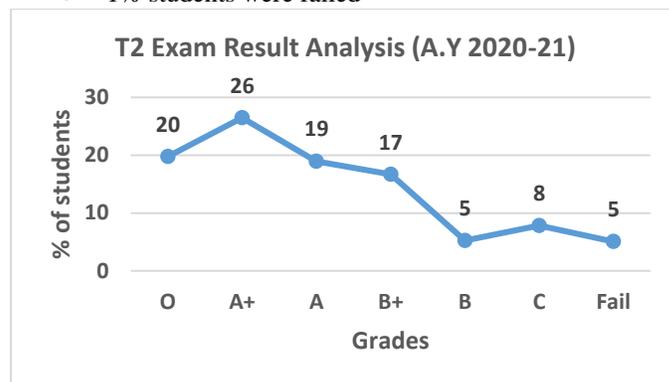


Fig 2 Pen & Paper mode

Fig 2 shows result analysis of T2 exam through pen & paper mode in A.Y 2020-21

- 20 % students scored Outstanding grade
- 26 % students scored A+ grade
- 19 % students scored A grade
- 17 % students scored B+ grade
- 5 % students scored B grade
- 8 % students scored C grade
- 5% students were failed

It is observed from the result analysis that through assignment mode students scoring Outstanding grade were more with better understanding of the related topics.

(B) Indirect CO Attainment

Following are the course outcomes (CO) which were assessed during T1 exam:

CO2: Students will be able to calculate Eigen values.

CO3: Students will be able to apply knowledge of Linear Algebra to solve simple real life problems.

Students responses were taken as follows:

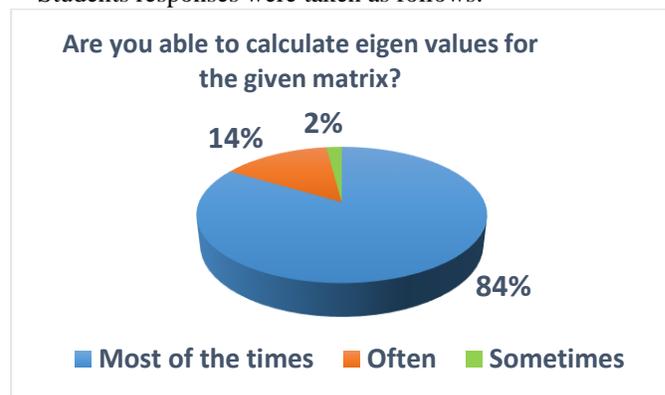


Fig 3: Percentage of students achieving CO2

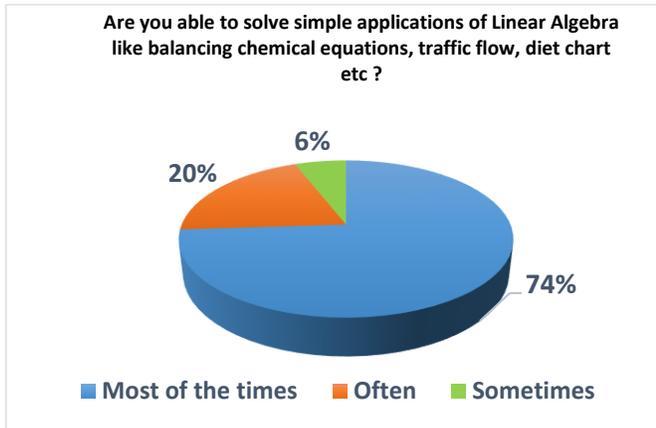


Fig 4 Percentage of students achieving CO3

Fig 3 & Fig 4 shows indirect course attainment of CO2 & CO3 through student's feedback.

- 84 % students are able to calculate Eigen values most of the times (CO2)
- 74 % students are able to solve simple applications of Linear Algebra (Unit3) like balancing chemical equations, traffic flow, diet chart most of the times (CO3).

It is observed that for both the course outcomes CO2 & CO3 course attainment was achieved with highest level.

(C) Students Feedback on Assignment mode for examination

The feedback was taken from students about the assignment mode of assessment to strengthen the teaching-learning process.

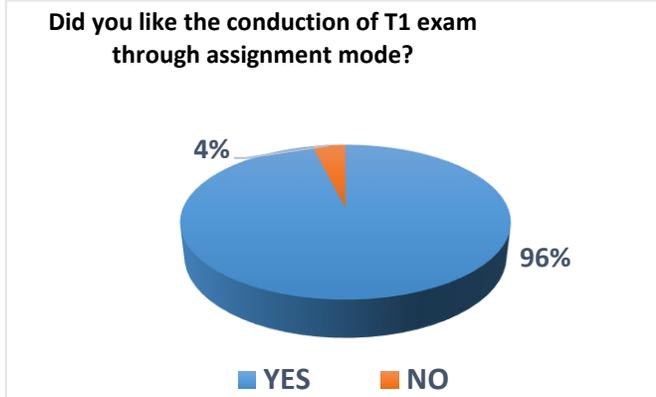


Fig 5: Students Response for conduction of examination through assignment mode

From Fig 5 it is clear that 96% students liked the conduction of T1 exam through assignment mode.

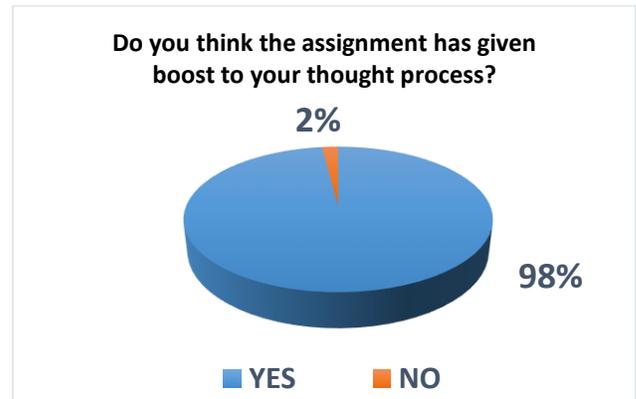


Fig 6: Percentage of students thinking assignment mode has given boost to their thought process.

From Fig 6 it is clear that 98% students think that assignment mode has given boost to their thought process.

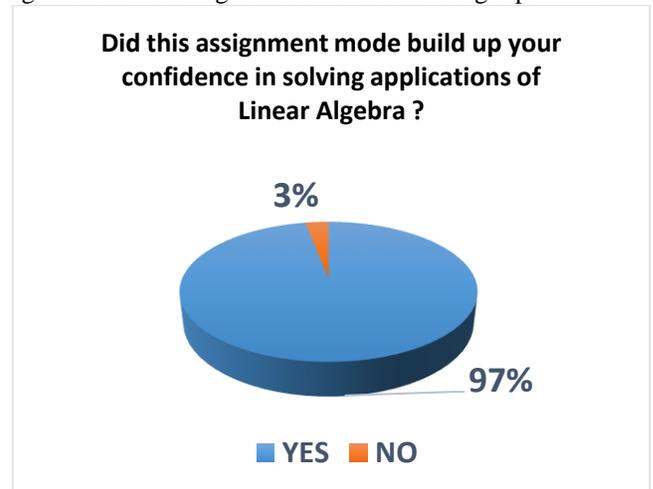


Fig. 7: Percentage of students thinking assignment mode has built up their confidence in solving applications of Linear Algebra Problems.

From Fig 7 it is clear that 97% students think that assignment mode has built up their confidence in solving applications of Linear Algebra problems.

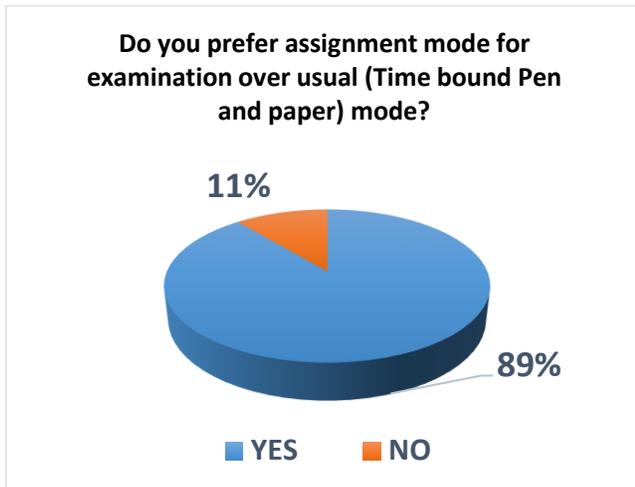


Fig.8: Percentage of students preferring assignment mode over pen & paper mode.

From Fig 8 it is clear that 89% students prefer assignment mode for examination over usual pen & paper mode.

V. CONCLUSION

In OBE, mode of assessment plays an important role in testing different competencies of students. Hence, deciding the mode of examination is very important. In subject like mathematics, course instructor tests student's knowledge in subject from problem solving ability. Through assignment mode discussed in this paper, student's ability to solve the problem independently is tested.

It is also important to examine the time student has taken to solve mathematical problem. In this paper, time-bound assignment mode is considered. From the student's submission timing, course instructor understands the problem solving speed of the student. It helps course instructor to analyze whether the student is weak student or not and can work to improve that particular student's problem solving skills.

Assigning different question paper to each student as an assignment, course instructor can make sure that each of the student has to think independently and differently in solving the assignment. All the students get same level of difficulty in question paper.

This novel way of assignment mode can also be implemented in offline mode of examination. Students should be given take home assignments and course instructors should ask them to submit online within the given stipulated time. The proposed method can be implemented for other courses also.

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