

# Experience Report of Creation of an OER in Applied Mathematics using ICT for Effective Teaching Learning

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**Abstract:** This report is about the experience of creating and implementing an ICT based teaching learning process with an Open Educational Resource of Applied Mathematics on MOODLE. MOODLE was used to host the Open Educational Resource (OER) created using different technologies. The report also describes the investigation carried out to evaluate the impact of the ICT based Learning on students in learning mathematics through MOODLE and a peer review of the implemented system. This work was done under the guidance of workshop coordinators from Indian Institute of Technology (IIT), Bombay during the AICTE approved FDP on - Use of ICT in Education for Online and Blended Learning.

**Keywords:** Open Educational Resource, Open Educational resources through Moodle, Engineering students, Moodle for teaching mathematics

## I. INTRODUCTION

The Open Educational Resources (OER) in Applied Mathematics that we have created is hosted on Moodle Cloud Platform and it was developed as a part of an assignment for the IIT Bombay's AICTE approved FDP in 'Use of ICT in Education for Online and Blended Learning'. According to the OER creation guidelines given, we were asked to select any one from a set of options which included creating a question repository on Moodle, Flipped classroom creation using Moodle, Video lectures etc. After the brain storming session of our team, we decided to create all the possible resources and use Moodle, which is an open source Learning Management System (LMS) as a hosting platform. The OER for Applied Mathematics on Moodle consists of,

- A collection of series of videos lectures
- Quizzes as an assessment tool.
- Sci-lab codes as a companion tools
- PowerPoint slides Used for Screen casting, which can be taken as a reference material for the Lecture notes.
- Question Bank as a practice material.

The above mentioned OER is created to learn the 'solution of a system of linear algebraic equations' by using 5 different matrix methods by watching the video lectures provided. At the end of each method some problems have

been given either in the video or on the MOODLE pages as question bank, for the learners to solve for themselves. This was done keeping in mind that this will take care of the achievement of first and second cognitive levels of the revised Bloom's Taxonomy namely *Remember* and *Understand*. The correctness of the solution obtained by the learner can be checked by executing the Sci-lab codes given separately on the Moodle platform. There are 5 quizzes to check the understanding of concepts and achievement of learning outcomes which cover the second and third levels of Bloom's Taxonomy. The presentation slides which were used for the screen casting of the video lectures were also provided as resources on the Moodle which can be used as reference notes for the Module of Solution of the System of Linear Algebraic Equations using Matrix methods. Technologies and Platform for used for the creation of this OER are,

- Screencast- O-Matic.
- MS Office 2010
- MOODLE Cloud
- Google Drive
- WordPress
- MS-Excel.
- SciLab

While constructing the Video lectures as a part of OER, it was kept in mind the fact that students of all categories should be able to use this OER and enjoy the learning environment using Moodle. Mathematics has been the most feared subject since decades and the main objective of the creation of this OER is to make the process of learning Mathematics to be stress free and enjoyable. Moodle being open source and easy to use was chosen to host all the resource materials of Applied Mathematics. It was observed that the learners who were instructed to use the OER on the Moodle Platform, very much liked the whole new learning experience. This observation was possible due to the evaluation process discussed in section 4 of this report. Section 2 is about the referred work for this report. Section 3 explains the step by step process of creation of the OER on Moodle. In Section 5 we discuss the result of the evaluation

process and section 6 gives acknowledgement to all the people who supported and inspired us for writing this report.

II. RELATED WORK

During creation of this OER on Moodle we did not get much time to go through many related articles but there were some articles which were in the similar category of our work. Sanchez, R., Hueros, D.[7] studied the motivational factors and influence of Moodle on graduate students and their study revealed that it did have a significant positive impact on the students with respect to the easy usage, online availability and distance learning environment. Robescu, D. [6] argued that the Moodle’s interactive content and outcome based learning settings and is increased the employability of engineering students. Paragină, F., Paragină, S., Jipa, A., Savu, T., Dumitrescu, A.[5], report the use of Moodle in the teacher training programs in Romania. They mention that getting permission to run a training program in an e-learning setup was a difficult task, but when they highlighted many features of Moodle like Discussion forums, chat sessions, quiz creation, lesson creation and many more, they were given permission and now the modification to the Laws in Education in Romania are in process. Paragină, F., Paragină, S., Jipa, A., Savu, T., Dumitrescu, A.[4] published one more paper in the same year which studied the e-learner’s needs and gave a solution in the form of Course Creation on Moodle. Hori1.,M., Ono, S., Kobayashi, S., Yamaji, K., Kita, T.[3] introduced the learning support systems platform which utilizes Moodle modules. This incorporated the new open education system, which offered E-book based courses linked to Moodle. Cooch, M., Foster, H., Costello, E.[1], used Moodle as a platform for MOOCs (Massive Open Online Courses). Their paper talks about the Moodle activities used in courses, level of participation etc.All the papers reviewed are talking about the ease of use of Moodle, various Modules of Moodle like forum, chat, lesson, database etc. in that perspective we decided to use Moodle as a hosting platform for our OER in Applied mathematics. The following technologies have been used for the creation of the OER.

TABLE I. TECHNOLOGY DECISIONS[2]

Sr. No	Technology Used	Purpose of Use In OER	Reasons For Selection
1.	MSWord	Documenting the Submission	Most familiar and widely used word processor on windows available with the team members
2.	MS Power Point	For Presentation In Screen casting	Availability of licensed version ,Familiarity of use, Most widely used and hence learners can use the downloads
3	Screencast-O-Matic	For video recording and sharing of lectures for use of learners	It is a freeware for smaller videos

4.	Wordpress.com web hosting site	Used to share the presentation slide files and the Scilab codes with the learners	It is free, The web pages have already been created by the team members
5	MOODLE Cloud	For uploading resources of OER for sharing between members ,for discussion between members ,for hosting the OER quizzes	It is free. It can be accessed by learners through guest login It facilitates setting up a MCQ quiz
6	Scilab	For creating the codes of Numerical matrix methods	It is open source software. It can be easily downloaded on a PC or Laptop. This will used for the validation of the solutions obtained by Manuel solving of system of equations

III. THE ICT BASED TEACHING LEARNING THROUGH MOODLE.

Mathematics as a subject, is supposed to be difficult to learn as per many surveys and research conducted for engineering students [8]. The reasons can vary from lack of basic knowledge to the vast syllabus teachers need to teach and students to learn. The traditional ways of learning mathematics may not be suitable to today’s generation of tech savvy students. So keeping in mind all these aspects we decided to use Moodle as and LMS to host various OERs and help students to learn mathematics in an easier way. This was an experiment to check if students can find it easy to use and learn mathematics without and prejudice about the subject. The plan was to create the OERs and host them on Moodle. Then students are instructed to login to Moodle and watch a video of a particular mathematical concept and then their understanding of the concept can be tested by various quizzes, question banks and Scilab codes available on Moodle. This part takes care of the Out-of-the-Class activity of a Flipped classroom. The In-the-Class activities were not tested but that is the future plan. If students become comfortable to this kind of learning then this method of learning will take care of the problem of syllabus completion and a lot of load can be taken off from teachers and students. Students can learn at their own pace in their own comfort zone and the teachers can implement learning by doing concept for the students. Many universities and teachers across Europe and the US have implemented this kind of model and have tested the performance of these models. Lopez, A.G. and Mazario, F.G.[9] used the model where they used google+ to host online quizzes, assignments, exams etc. in the conclusion they have mentioned that students gave a positive feedback on the online blended learning of mathematics. McElroy, J., O’Loughlin, J., Townsend, C., Simonovits,, R [10] had also developed a similar kind of model, where they used Moodle as LMS and math software M@th Desktop in combination for quizzes assignments and projects. They also have emphasized on the aspects of ease of use and technology advancement. Similar kind of work is discussed in few more research papers. [11, 12]

#### A. Creation and hosting of Moodle Cloud account:

The Moodle cloud platform used for hosting our OER was created as an assignment during the IIT Bombay's AICTE approved FDP in 'Use of ICT in Education for Online and Blended Learning'. When we had to take the technological decision, we decided to use Moodle as our hosting site as Author 1, Ms. Poonam knew some of the features of it, as she had used it in her college for 2 years as a LMS (Learning Management System). But she had used it only to upload the resource materials. We came to know about the strength of Moodle when we attended the workshop conducted by IIT Bombay. When we created our own Moodle and went through the Moodle documentation, we came across various features of Moodle such as forum, chat, lesson, database, quiz etc. and after successful attempt at knowing how to use them while creating a course in Moodle to host our OER we decided to use it as our official hosting site of Our OER in Applied mathematics. For the options like course creation in Moodle, adding new user in Moodle, enrolling user to a course etc. one can visit moodle.org for documentation.

#### B. Procedure to access Moodle for OER

Step 1: Copy Paste the following link in the URL bar and search to get the home page of the MOODLE home page of the team: <https://madaboutmathematics.moodlecloud.com/>  
Step 2: This will take you to the following page. Then select login option to the top right corner as shown in the following screenshot.

Step 3: Step 2 will open a new page for login as follows. Then enter your login id and password on this page 1. User-id=Student 2. Password= Student1@

Step 4: After login you will be taken to the Course page where you can see all the tabs for resources of Applied Mathematics like video lectures, quiz, Scilab codes, video lectures, PPT slides of presentations used in video lectures, question bank of problems for practice etc. Click on the required tab to access the required resource.

Step 5: Once in this page you can click on the 'Applied Mathematics' to view the videos and for attempting the quiz that you want to attempt.

Step 6: Other resources can be accessed by clicking on the appropriate resource name on the same page. Or alternatively you can watch this short screen cast giving guidance on how to access Moodle for OER. <https://youtu.be/wbIJNyBVYIE>

#### IV. EVALUATION:

Various resource materials were created using different tools as mentioned in section 1 of this report using different technologies mentioned in section 2 of this report. Apart from OER we also created the feedback questionnaire for Students as well as Peers for taking their valuable feedback about the use of OER and ease of using Moodle platform for innovative learning and to know about the impact it made on learners with respect to use of technology in learning mathematics. Effectiveness of this OER was decided to be tested on two levels, by taking feedback from the Learners and peers regarding the ease of use of this OER, level of understanding of the concepts, application of the methods learnt to solve examples, assessment for

conceptual understanding by attempting quizzes etc. Following are the questions used for each of the feedback.

#### A. Measuring the Effectiveness of the Proposed OER

Following questionnaires [8] were created to check the impact of the new learning process through MOODLE. The questions were designed by keeping tab on the learning objectives.

##### 1) Feedback Questions for Students

- The Video lectures were easy to understand.
- After watching the videos I felt confident of being able to use this knowledge to solve the system of equations
- I was able to attempt the related quiz successfully after watching the videos
- I think that I would like to use this OER of Applied Mathematics frequently
- I found this OER of Applied Mathematics unnecessarily complex.
- I think that I would need a support of a technical person to be able to use this OER of Applied Mathematics.
- I needed to learn a lot of things before I could get going with this OER of Applied Mathematics
- I would imagine that the most people would learn to use this OER of Applied Mathematics very quickly
- I thought there was too much inconsistency in this OER and I found the OER system very cumbersome to use.
- I found the various functions like taking a quiz or a feedback in this OER of Applied Mathematics, were well integrated.

##### 2) Survey Questions for Peers

- The guidance given to use this OER of Applied Mathematics was easy to understand and the link between the resources was very clearly instructed.
- The learning objectives mentioned in the video lectures were satisfied by the available resources.
- Creative Commons License was given to all the resources and it was visible.
- This OER of Applied Mathematics satisfies the objective of 'Easy to use'
- This OER of Applied Mathematics covers at least 5 of 6 levels of the revised Bloom's Taxonomy such as remember, understand, apply etc. through video lectures, PPT slides and quizzes.
- I found this OER of Applied Mathematics to be unnecessarily complex.
- I found this OER of Applied Mathematics very cumbersome to use
- I think the learner will need the support of technical person to be able to use this OER.
- I would imagine that most of the learners would learn to use this OER very quickly.
- I feel that this OER will help learner to learn Applied Mathematics in an innovative and easy way.

These questions will be measured on the 5 point Likert scale of strongly disagree-to-Strongly agree. The responses then will be converted to scores and the analysis is given in the form of bar charts with percentage of responses for a point. The questions used for the feedback and evaluation can be put into two categories as follows:

Group 1: Questions to assess the ease of use and user-friendliness of the OER and the LMS Questions 1,2&3 belong to this group.

Group 2: Questions to evaluate the ease of learning and the effectiveness of the videolectures for learning the topics discussed. Questions 4,5,6,7,8,9 &10 belong to this group. The figures below give an insight into the learners comfort level of using the OER understanding of the content in an innovative way and using Moodle as LMS. The trend looks positive as per their strong opinions found. The discussion about the same will be done in section 5 of this report

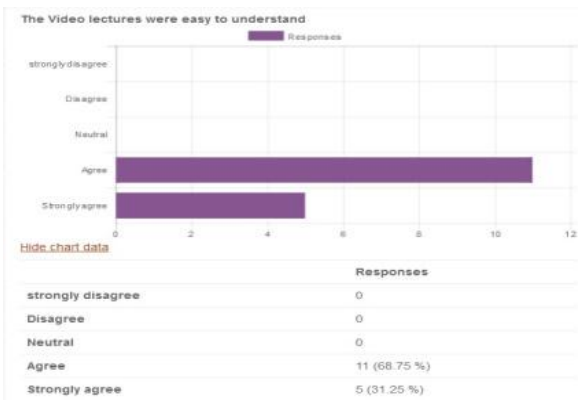


Fig. 1. Responses for question 1 received from students

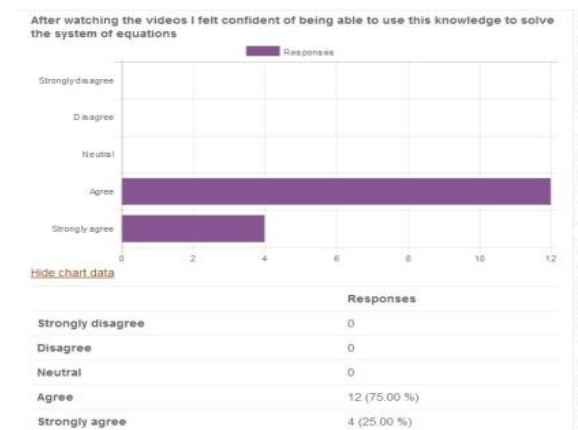


Fig. 2. Responses for question 2 received from students

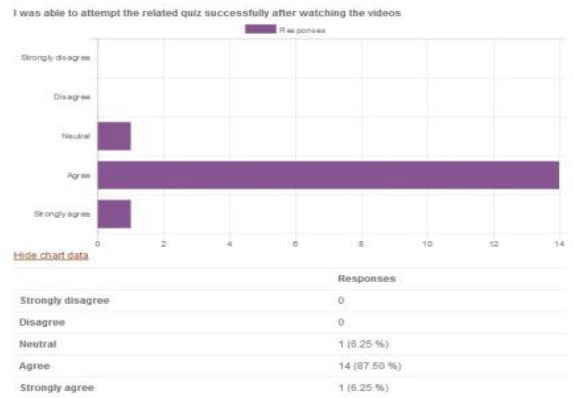


Fig. 3. Responses for question 3 of received from students

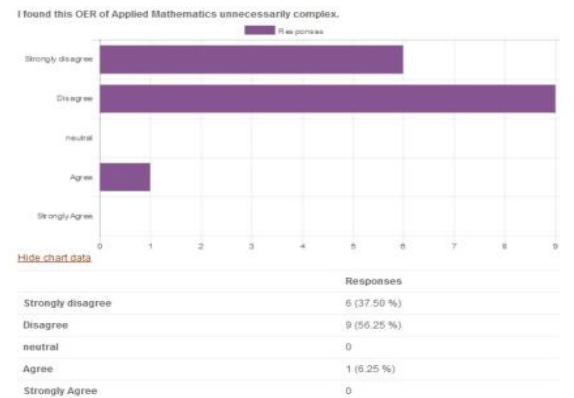


Fig. 4. Responses for question 4 received from students

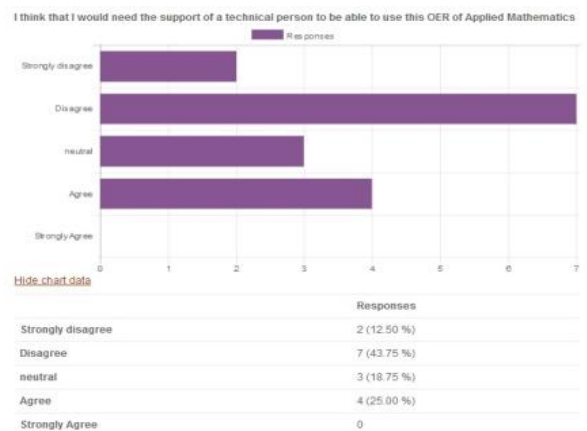


Fig. 5. Responses for question 5 received from students

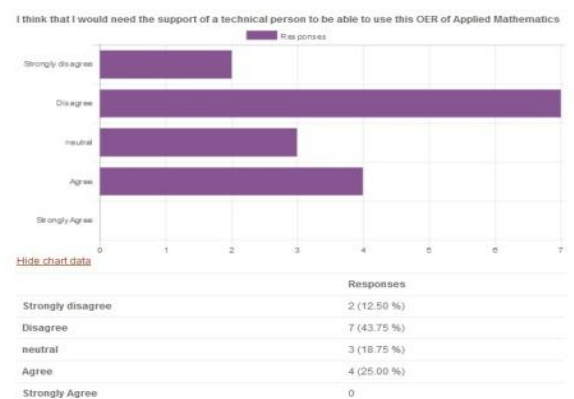


Fig. 6. Responses for question 6 received from students

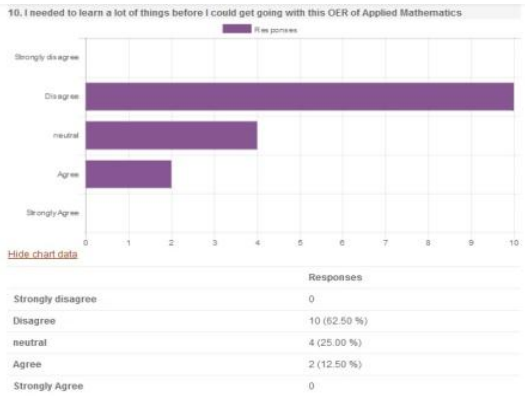


Fig. 7. Responses for question 7 received from students

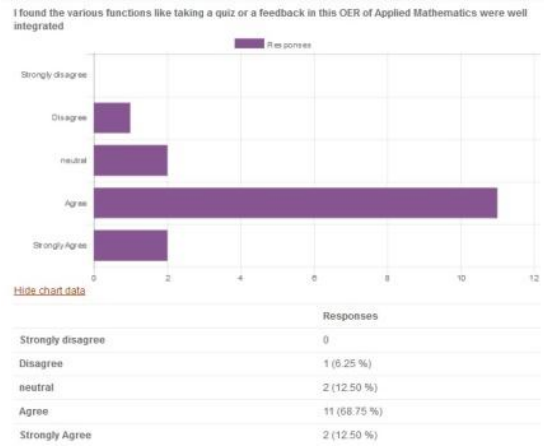


Fig. 10. Responses for question 10 received from students

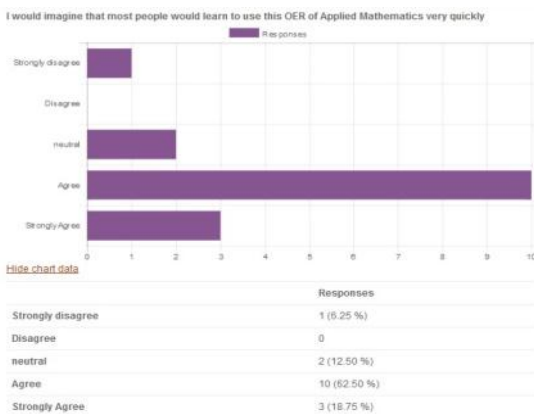


Fig. 8. Responses for question 8 received from students

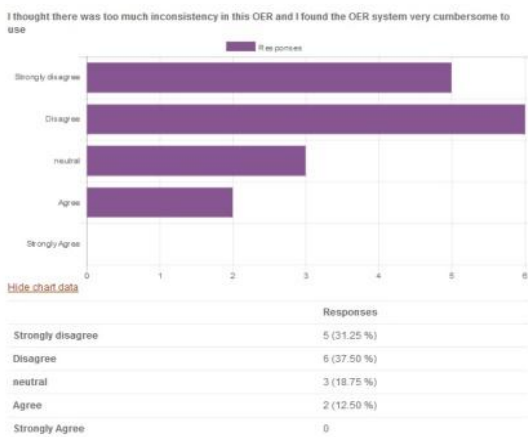


Fig. 9. Responses for question 9 received from students

**B. Discussion of the evaluation process:**

The figures above depict the result. According to first three figures which are from group 1, it is quite clear that the students find online learning of mathematical concepts easy and interesting, giving them a sense of ownership as they were able to attempt the quizzes immediately after watching videos. Students have given a clear indication that they liked this new innovative method of accessing Moodle for OER, very easy and simple. They also liked the video lectures and found them lucid and simple to understand. They showed interest in using the question bank for practicing more examples. They are in the anticipation of getting access to more such OERs in future. Some students shared that they felt very comfortable as they could learn the things at their own pace and were not forced by anyone to finish the task in a limited time and because of that they learned faster as they were in their comfort zone. According to Fig.4 to Fig.10, some students were showing a little hesitation toward the entire process, but soon they got accustomed to the Moodle environment. The possible reason for the positive responses in Fig. 3 is that learners were actually *learning by doing* which is one of the best methods to learn. For the peers, they were surprised to see this platform for teaching mathematics. Some faculties did show concern about the ability of students to understand the use of Moodle for accessing of the OER. After they used it themselves and saw other students using the platform with ease they were happy for this initiative. They showed keen interest to learn this and use it for their own course. The responses received in for the survey conducted for the peers showed a strong trend towards the positive side of all the questions asked, it shows that Peers are in favour of using Moodle as a host to upload their teaching resource.

**CONCLUSION AND FUTURE WORK**

The experience of using Moodle as a platform for hosting Open Educational Resources has been phenomenal. We will try to exploit all the resources available in Moodle for using as an innovative Teaching tool for teaching mathematics. The OER created and hosted on Moodle are published under the creative commons share-alike license. Which makes it an open source platform and any of the peers wish to collaborate with us for building up a larger

OER using the current OER are welcome to contact me and my teammates. We would like to extend this platform to use it as the Out-of-the-Class activity in the Flipped classroom perspective. My team members and I are interested in collaborating for creating resources falling under any of the broad areas listed below.

1. Applied Mathematics for Engineers.
2. Applications of mathematics in real life problems
3. Creation of text book companions as OER

#### ACKNOWLEDGEMENT

We sincerely thank all the coordinators of the workshop approved by AICTE and conducted by IIT Bombay for imparting the knowledge about the use of ICT in Education and training us in so many innovative teaching tools. We have learned a lot during this Faculty Development Program (FDP). The workshop faculties of IIT Bombay are extremely resourceful and talented. They have helped us at every step of the training. One can imagine the efforts they have put in to design and execute this course, as we took so many days only to complete this one task and they have planned and executed a perfect training program without even a single glitch. We specially want to thank Prof. D.B. Pathak, Prof. Sahana Murti, Prof. Sudhir Iyer and Mr. Jayakrishanan M. for lending a helping hand on every step of the way, also for this wonderful learning experience and for taking so much pain for such a thorough training. We hope to attend more such workshops in future.

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