

BodhiTree – An Effective Learning Management System for Implementing Active Learning Strategies

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Abstract – The prime challenge faced in the pandemic and post pandemic period is involving students in active learning. In the absence of physical classes, learning Management System (LMS) is the only option for implementing active learning strategies. BodhiTree is an open-source online learning platform developed by IIT Bombay and endorsed by AICTE to empower teachers to conduct online classes and later even regular physical classes via flipped mode. Authors have used the platform for teaching learning of the subject heat transfer for undergraduate engineering program at third year level. The present article discusses the implementation of BodhiTree for teaching of the said course. The process of teaching a course using the platform from enrollment to the assessment and publishing grades of the student who appeared for the course is outlined in the present article. The article also discusses the convenience and features of BodhiTree over other free active learning platforms and the limitations faced by the authors during its implementation. The comparative assessment of course outcomes' attainment levels show that, implementation of BodhiTree has resulted in better understanding of fundamental concepts by the students. BodhiTree is found to be the most user-friendly active learning platform for teaching undergraduate courses.

Keywords—Active Learning Strategy, LMS, BodhiTree, Course Outcomes

I. INTRODUCTION

The unprecedented pandemic situation has changed many aspects of human life. Its impact on the education sector is inevitable. Prior to the pandemic situation people believed there is no alternative to classroom teaching and although many other methods of learning are available. Classroom teaching cannot be replaced with other methods. In the pandemic period attending the regular classes was not possible and online lectures were the only

option available for teaching learning process. Although the mode of lectures was shifted to online almost in all the countries, developing economies faced a lot of limitations like availability of gadgets, bandwidth etc. in the online lectures. Adjusting to the extraordinary situation, teachers have adapted to the online teaching mode. However, student engagement in the online environment was the foremost challenge faced by the teachers.

Google has supported the lecture recording facility so that if the student misses something, he/she can go back to the recording and watch that part again. It was observed that students rarely do so for many reasons like bandwidth availability or connectivity. Further there is no feedback mechanism in the lectures to know for understanding the students' engagement in the lecture.

Considering the diminishing attention span of students, an active learning strategy is the key factor in designing the curriculum of higher education across the world. An active learning strategy is any type of activity that engages learners in deep thought about the subject matter. In traditional lecture mode students are just receiving course contents passively. Whereas in active learning mode students become part of the learning process. Many active learning strategies are suggested by experts and practiced by teachers. Some of them are group discussions, Flipped Classroom, Think/Pair/ Share etc. In regular classes these active learning strategies are used effectively and its use is evident through the students' feedback. The use of online classes during the pandemic resulted in digital transformation in the education field. In online classes, implementation of active learning strategies needs an effective learning management system. Authors have used the BodhiTree platform for teaching the

subject 'Heat Transfer' offered at 5th Semester of undergraduate Mechanical Engineering Course.

II. LITERATURE REVIEW

Implementation of active learning strategies during online classes is another level of challenge. Teachers have employed different strategies during online classes and reported the results.

Smallwood and Schooler (2006) have shown that mind wandering is a big hindrance in the educational environment. Mind-wandering creates a state of decoupled attention. This further results in, inability to grasp the information in the first instance. This failure cascades downwards through the cognitive system leading to failure in building required models for reading. Donald Bligh (1985) also mentioned that lecture is just a means for information transfer. He further added that teachers should not rely on lectures if they want to promote thoughts, develop behavior skills or change the attitude of the students.

Hatta et al. (2020) have reported five different active learning strategies used by different investigators. Online tools like Kahoot and other voting/polling applications can be used as a student response system. By noting responses, the instructor can decide whether to continue the teaching, provide additional instructions or repeat the instructions if learning objectives are not met (Wang & Tahir, 2020). Group discussion is one of the most effective active learning strategies wherein students in a small group like 4-5 students discuss the problem statement given by the teacher and arrive at a solution. Group discussion supports the problem-based learning approach and can be considered as an active learning strategy (Silberman, 1996). Although typical classrooms in India are using low level technology for active learning, comparison by Nicole et al. (2017) concluded that there is no significant difference in outcomes while using high-technology active learning and low-technology active learning.

There are many learning Management Systems (LMS) free and paid. The active learning strategies can be implemented using these different learning management systems or online platforms like Moodle, Canvas or to some extent Google Classroom. Every learning management system has its costs and benefits.

Jafari et al. (2015) have studied the factors which contribute the success of LMS by using information system success model put forth by DeLone and McLean (2003). Usefulness of a particular LMS is the extent to which it helps in enhancing the students' performance. Usefulness of a system depends following factors. First factor is the quality of system i.e., the design of software from user point of view or ease of use. The second factor is the quality of the e-learning material developed by the teachers. The last factor is readiness of the system for online learning (Mahadevaiah & Joshi, 2019). DeLone & McLean (2003) concluded that the information quality and system quality are the major parameters affecting system use and user satisfaction. Pandemic situation has underlined the need for the implementation of user-friendly LMS in higher education. Veluvali and Suriseti (2021) have reviewed the effective use of LMS to make teaching learning process interactive and student centric. They have summarized that, development of customized LMS done by considering institutional constraints proves beneficial. If LMS is used for course content creation and delivery, face to face interaction in classroom can be effectively used for better engagement of students with the course content by employing various innovative and creative strategies.

Sharma and Singh (2017) have done the review of various open source LMS available such as Moodle, Moodle Cloud, BodhiTree, blackboard and canvas instructor. It was observed that evaluation through LMS is mainly based on MCQ quizzes and short answer questions. There are limitations of LMS in conduction of theory examinations. Bervell and Arkorfu (2020) have defined a model for LMS enabled blended learning which considers relationship amongst facilitating conditions, voluntariness of use by tutors and use behavior of LMS. The study was conducted from teachers' point of view who had not employed and experienced LMS earlier. It was summarized that if facilities such as the availability of internet, technological support are available, teachers will willingly use LMS. It was also noted that, If the use of LMS is not made mandatory, teachers are less likely to employ it.

The cited literature brings out the importance of competent LMS in the pandemic situation and thereafter for effective teaching learning. Authors have compared the three free LMS Moodle, Canvas

and BodhiTree from the ease of use and implementation of active learning strategies point of view. Among these learning management systems, BodhiTree is found to be more user friendly from instructor and students point of view and has a blend of various useful features of different LMS available.

Bodhitree is an open ended platform developed by Indian Institute of Technology (IITB). The most important and distinguished feature of Bodhitree is the Multimedia Book Format of a course. In the multimedia book format, the chapters are arranged as per the usual textbook format contains sections and subsections. However, these sections and subsections have interactive videos wherein students must answer the questions while watching the video. The questions are based on the part already covered in the video. This feature engages the student in the learning and supports the Flipped Class Activity. It also has auto graded quizzes and laboratory assignments. For subjective questions, a human assisted grading facility is also available in Bodhi Tree.

III.IMPLEMENTATION

The subject 'Heat Transfer' is offered at 5th Semester of undergraduate Mechanical Engineering Course. The course is a core mechanical engineering course. Being a fundamental course, it needs conceptual understanding and thus active participation of the students in learning is imperative. In classroom teaching, instructors get constant feedback about students' understanding through quizzes and solving numericals through discussions. In the pandemic period, teaching mode is transformed to digital and such feedback is rarely available. Hence authors employed the BodhiTree platform for this fundamental course to ensure active participation of the students and in turn enhance conceptual understanding.

Bodhitree is very useful to get constant feedback about conceptual understanding through invideo quizzes and the multimedia book is very useful for flipped classroom sessions. Based on the performance of the student in the given quiz, part of the concept or the entire concept can be rediscussed in the class. Thus, quality time of a lecture can be spent in solving numerical problems that ultimately results in developing analytical skills of a student rather than discussing a theoretical part.

The following section discusses the step-by-step process of implementation of BodhiTree for the course Heat Transfer.

A. Creation of the course

Instructor must create the course through the instructor account. Creating a course is elementary just needs a single click.

Fig.1: Creation of course using BodhiTree

B. Enrollment of students

Students can be enrolled by two methods;

1. Bulk enrollment using .csv file
2. Students can sign up by email. But through this method roll no. cannot be assigned to the students. Instructors need to manually *change the tag of the roll number*.

Full Name	Email	Roll No.
KININGE RUCHA JITENDRA	rucha.kininge@cumminscollege.in	2775
PAWAR PRANALI MAHESH	pranali.pawar@cumminscollege.in	2776
KHUSHBOO SANJAY KAUL	khushboo.kaul@cumminscollege.in	2724
KAMBLE VISHAKHA VINOD	vishakha.kamble1@cumminscollege.in	2723
Sakshi Joshi	sakshi.r.joshi@cumminscollege.in	2721

Fig. 2 Enrollment of students using BodhiTree

C. Content Creation

As discussed above BodhiTree uses the concept of Multimedia Book. It has chapters, sections and subsections like a normal book. Instructor creates the chapter first to which the section and subsections are added subsequently.

Fig.3 shows the multimedia book of the subject Heat Transfer. In the book there are six chapters created. The chapter can be imported from another multimedia book or simply created by the instructor. A chapter includes different types of content like texts and videos. Inclusion of textual content in BodhiTree is very similar to other LMSs. Instructor can add Quiz, assignment or notes in a chapter for ready reference of the students.

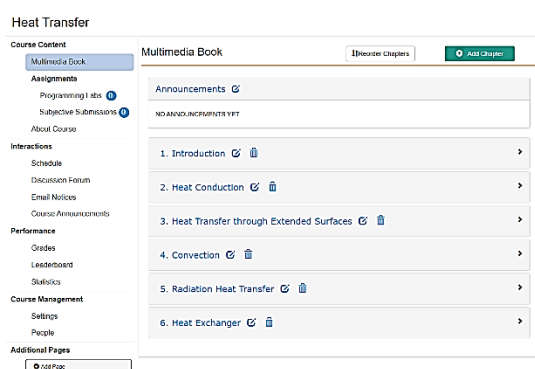


Fig. 3 A multimedia book of Heat Transfer on BodhiTree

Video Content -

The distinguishing feature of BodhiTree is the inclusion of interactive videos. Earlier instructors need to upload the videos on online video sharing platforms like YouTube. Bodhitree offers following advantages over YouTube video uploading.

- The videos are interactive
- Instructor can put marker in the video. Student can jump to a particular content
- No advertisements so no distraction
- Invideo quizzes can be graded or ungraded
- Instructor has a control who can see the video
- Instructor can check who has watched the video

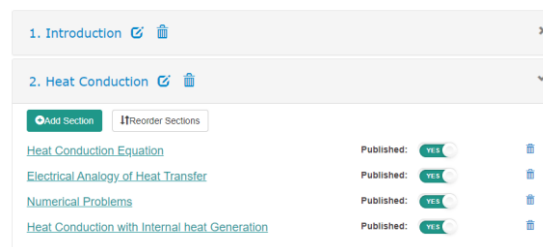


Fig. 4 A topic in the multimedia book of the subject Heat Transfer

Fig. 4 shows the sections in the topic Introduction created in the multimedia book of the subject heat transfer.

The chapter includes documents (Heat Conduction Equation, Assignment), a quiz and a video. The video embedded in the section is interactive video about the modes of heat transfer. The video has inbuilt questions. The questions embedded in the video can be graded or non-graded. Fig. 5 shows a sample of video and quiz embedded in the video. Students are able to see the video markers on the left hand side. One can jump to the part of the video he/she wants to watch. Interactive video keeps the student engaged in watching the video as assignment questions are embedded in the video. The video marker makes it easier for students to jump to a particular question/part of the video and thus gives opportunity for reflection. Thus an active learning strategy flipped classroom can be effectively implemented using BodhiTree.

D. Discussion Forum in BodhiTree

Another effective active learning strategy is group discussions. Studies have shown that group discussion/peer review helps students learn new concepts quickly rather than passively listening from instructors. Discussion with peers makes them ready for independent learning and promotes an enriched understanding among all participants (Mercer & Howe, 2012).

Discussion with peers prompts students to pause and reflect upon their learning. In a digital mode group formation and assigning the task was not possible. BodhiTree has a group discussion feature. Authors have instructed the students to use the platform for posting their queries and encouraged other students to answer it there. It was also announced that the instructor will put the summary of discussion at the need of every thread. However, there was no response from the students to this. Authors are investigating the reasons for poor response to this feature.

E. Grading Students and releasing grades using BodhiTree

BodhiTree is an excellent tool for grading assignments and releasing the scores to the individual students. The subject Heat Transfer does not have any graded assignments, authors have not used this feature. Instructors can communicate the score to students through email or scores can be made available through leaderboard. The

leaderboard can be exported to .csv file for further processing.

IV.DISCUSSION

Implementation of BodhiTree has not only helped the students for easily grasping the fundamentals it also has helped the instructor for better lecture planning and execution. There was no direct feedback mechanism for getting feedback about teaching during online classes. Authors have tried the use of tools like mentimeter. But its use was

limited as most of the students prefers to abstain from the voting due to fear of getting wrong.

Considering the limitations of free online survey tools and other similar mechanism, authors have used invideo quizzes as a tool for feedback. The subsequent lectures were planned based on the feedback received through the Invideo quiz

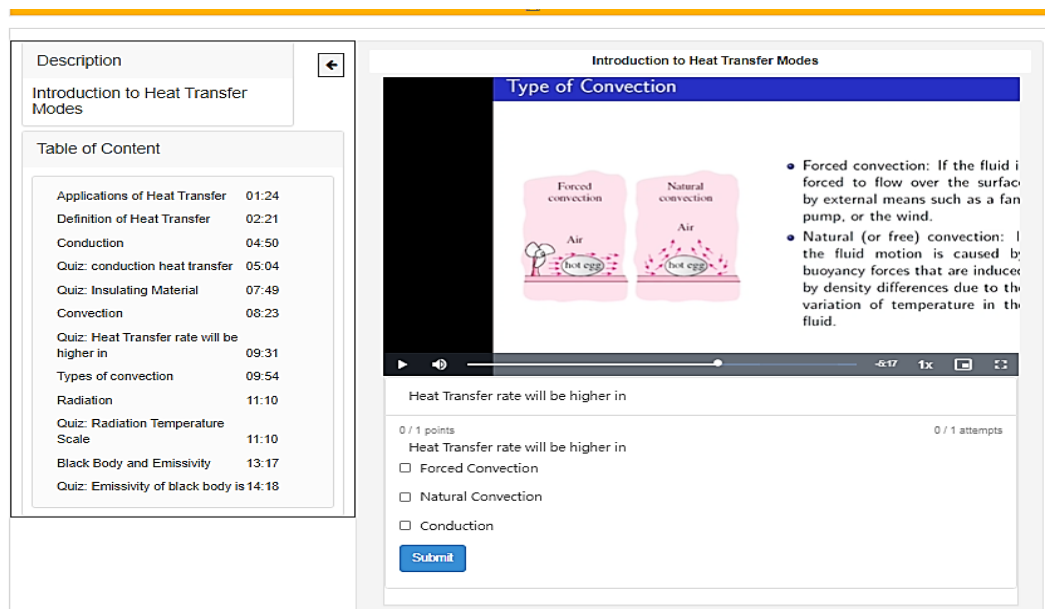


Fig. 5 Interactive video included in a chapter of the multimedia book on heat transfer in BodhiTree

The first invideo quiz was based on 'Modes of Heat transfer'. The video contains some real-life examples of heat transfer processes and the dominant mode of heat transfer in them was explained. The law of governing the heat transfer mode in that application is also explained after each mode. Questions based on the law and applications are asked during the video. Fig. 6 shows the responses of students for invideo quiz 1. It was found that the mode conduction and its governing law were well understood by the students. Students faced difficulty in understanding the basics of

convection and radiation. Taking this feedback, the instructor has again discussed the topic in special online class.

F. Limitations of BodhiTree

Nonetheless BodhiTree has proved useful in employing active learning strategies in undergraduate education, authors have observed following limitations while using it. BodhiTree being an open-source platform, no elaborative user guide is available for students. Enrollment process should be more hassle free and easy.

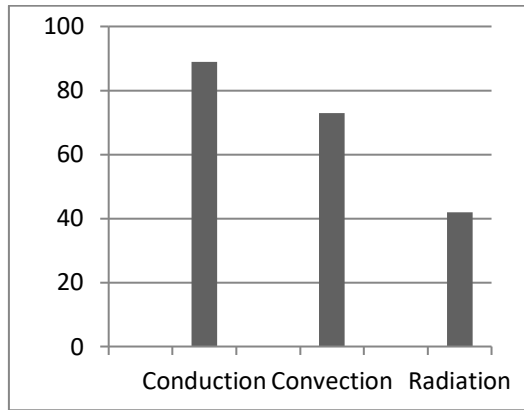


Fig. 6 Percentage of students attempting all the questions for various modes of Heat Transfer

The installation of BodhiTree requires thorough knowledge of the Linux operating system. In many educational institutes dedicated system administrator is not available. A windows and other operating system based simple installation file should be made available.

V.RESULTS

The effectiveness of BodhiTree as a learning management system can be accessed by comparing the attainment level of course outcomes with the last academic year. Attainment level is an indicator of the status of learning that has been achieved by a student.

For the course of Heat Transfer, six Course Outcomes are defined. The course outcomes are as follows;

CO.1 Apply laws of heat transfer to ascertain the heat transfer rate in steady and transient state heat conduction in solids

CO.2 Formulate the equation for heat conduction with heat generation applying suitable BC's

CO.3 Evaluate the requirement of extended surfaces for heat transfer and calculate the heat transfer enhancement using it.

CO.4 Analyze the convective heat transfer rate using appropriate correlations.

CO.5 Predict the heat transfer rate in radiation mode and with the use of radiation shield.

CO.6 Calculate the efficiency of heat exchanger for given set of operating conditions.

The attainments of the course outcomes are calculated by taking in to account students' performance in the end semester examination as well as in the inSemester examination in the form of online and invideo quizzes conducted via LMS. Five percent contribution to the attainment is from End Course Survey conducted at the end of the semester. End course survey of the course comprises questions based on the understanding of the course by students. It is students' perception of the attainment of the course outcomes.

The attainment for the course outcomes was calculated for pre pandemic academic year which is 2019-20 and academic year during pandemic era which is 2020-21. Fig. 7 shows the comparison of the CO attainment for pre pandemic academic year. It can be seen that for CO1 and CO6, attainment remains unchanged, while for CO2, CO3 and CO5 there is improvement in the attainment of the course outcomes. Rise in attainment levels clearly indicates that, in spite of not having face to face classroom interaction, students were able to grasp the concepts of this fundamental course in the mechanical engineering program.

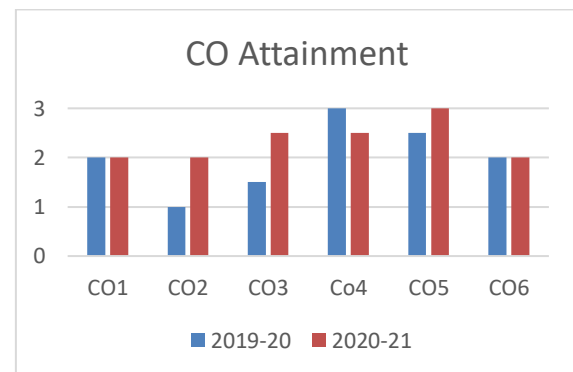


Fig. 7 Comparison of the CO attainment levels

Employment of the LMS - Bodhi tree has a major role in increase in attainment level of the course outcomes. The vital role of BodhiTree in understanding course concepts was further confirmed by the feedback received during mentor meetings. BodhiTree facilitates the learning in following ways;

- Students could revisit the important concepts and enhance their understanding of the lecture content at their own pace.
- In Video quizzes helped in reflecting on the content covered and final quizzes bolstered

their overall understanding of the subject matter

- Discussion forum promoted peer learning among students.

Considering the rise in attainment levels and students' feedback BodhiTree has been proven as an effective learning management system for the course Heat Transfer.

VI.CONCLUSION

Authors have successfully implemented BodhiTree Learning management System for teaching the subject Heat Transfer at 5th semester of undergraduate course in Mechanical Engineering. BodhiTree is found to be one of the most effective freely available platforms for executing active learning strategies while teaching the course. The comparison of CO attainment levels of the years when BodhiTree is used and not used, showed that the attainment levels are more for four out of six course outcomes when Bodhi Tree is implemented. Further, this rise in attainment level is achieved when there was no classroom teaching in the pandemic period.

This concludes that BodhiTree can be successfully used for implementing active learning strategies in online and offline classes. It facilitates in inculcating fundamentals of a core subject for students. For an instructor BodhiTree offers better user interface and ease of working over other open-source learning management systems. Thus, BodhiTree proved to be an effective learning management system for active learning.

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