VMATE – Intelligent E-Learning Management System for Educational Institutions

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Abstract. The world is facing a huge health crisis which is demanding to reorganize the way it functions from square one. The spread of the pandemic, the shutdown of education institutions, and the shift to online learning were so fast that it barely gave any time to consider the difficulties faced by students. This is a great opportunity where educational institutions will shift to blended learning; hence it will become a new way of learning where there will be a need to find new ways to deliver the best content by using learning management systems. Therefore, the virtual learning world will create a great impact on the current education system due to the diverse effect of the epidemic. Hence different organizations are tremendously advancing their technology, and it will become more crucial over time. VMATE – Intelligent E-Learning Management System provides an interface for learners, which is of great significance and practical value for the improvement of learning and teaching quality. The use of Computers and the Internet has introduced technological conditions for teachers and students who can make good use of online information provided and communicating with others. This can be used by institutions and for different environments, where they can have computer-based instructions, blended-learning, and increased quality and quantity learning.

Besides some basic management functions, the system focuses on assignment grading, assessment for various learning courses which makes it suitable to provide personalized grading and detailed feedback.

1. Introduction
The world today is facing the largest public health risk which is resulting in one of the biggest and fastest reorganizations of the global order. By the end of March 2020, the epidemic has unfolded to over 185 countries and resulted in the closure of over ninety percent of all schools, colleges, and universities impacting near to 1.38 billion students [1].

The closure of schools and universities has widespread individual, organizational, and learning and teaching implications for the students, faculty, directors, and also the institutions. The initial stage of speedy adaption during 2020 contained 3 primary responses to COVID-19: minimal legal response, delayed commencement of study periods, and speedy digitalization of curriculum [2] [3]. The closure of schools and colleges not solely interrupts the teaching for the students around the world; the closure additionally coincides with a key assessment period and a lot of exams have been rescheduled or canceled. In India, more than thirty-two crores of scholars and students have been affected by the several restrictions and the worldwide lockdown.[4]. As per the United Nations Educational Scientific and cultural organization report, about 14 crores of primary and 13 crores of secondary students are principally affected which are the two most affected levels in India [5]. On the bright side because of the epidemic, the world has stayed connected globally through the internet. Earlier it was exceedingly
difficult to spread knowledge globally through the net. Earlier it was extremely tough to unfold information, but today it is very easy to share and learn by using the Internet. The Internet has helped the education system a lot by introducing a concept referred to as e-learning based Learning Management System (LMS). Several institutes started using these systems for serving different department needs. Generally, an online learning management system contains different components or modules [22],[23],[24]. A course management module provides facilities for adding new courses, managing, or updating existing courses, assigning teachers to courses, and other course-related details. [6] The student management module contains student enrolment, student registration for regular and elective courses. This is an especially important module for other modules to work properly with accuracy. In the online assessment module, the student can upload the assignment electronically so there is no need for submitting it by using paper [3]. Therefore, it saves a lot of papers. [6] A teacher can upload tutorials, videos, and other useful materials using an online course material management module. With the help of using this module, the student can view and download these files for study. In the feedback management module, students can give feedback for each subject, and teachers and only authorized persons can view the feedback. This is an immensely helpful module for teacher assessment.[6]. It provides prompt and efficient output as compared to a manual feedback system [8]. E-learning has rapidly evolved from just a thing of the future to a very practical approach towards education. It will continue to be an extremely useful classroom teaching tool as well as a self-study platform for learners. [7] E-learning approaches offer a vastly more engaging classroom atmosphere as well as the option for a fully tailored and self-paced online curriculum for home learning. The new advancements in learning technology have helped to support learners. Hence in this paper, we propose one such platform for improving the experience of learning effectively, especially during the pandemic like COVID-19 and other crisis. Hence it provides us an opportunity to improve our present education system.

2. Related work
This year 2020 has been the widely effected year where the world is at various points in pandemic rate, overall, there are about 1.2 billion children in 186 countries affected by shut down of institutions due to the epidemic. Hence, the education system has changed a lot, with the rise of E-learning, which is being delivered on online platforms. Even before the pandemic, there was high growth in online earning, with overall investments for online education. There has been a drastic growth in E-Learning when services like online learning software, conferencing tools, and online tutoring platforms were introduced. Now, many online learning interfaces are providing free resources, including some platforms like BYJUS, which is an online learning application. Hence a single platform is being provided by other firms for both the teachers and students. For example, Lark, a Singapore company took the initiative for providing intelligent planning, auto-translation tools, and unlimited video conferencing time, with many other functionalities. Keeping in mind the functionality and usability, Lark has upgraded its global server and engineering techniques to make sure the connection is reliable [9]. To experiment using a virtual laboratory Mihaela M. Albu et al. introduced a system based on the online web. The system is used for multiple purposes and developed in the LabView environment. [6] The main benefit of this system is that the students can access their laboratory equipment's from anywhere across the globe. The main goal of the system is to conduct practical power engineering using this virtual laboratory.[6] [25] Since there are various e-learning software's available in the market. There is confusion about choosing a system for an institute. A web-based learning system introduced by Nadire is an easy way to evaluate Learning Management Systems [10]. It is a decision support system, which gives the users a choice to select between the best learning system based on their requirements. Almost all learning systems are based on open source technologies. Raja Maznah Raja Hussain and Hamsiah Mohd Dahalan proposed an online learning management system to help with the teaching and learning of institutions [11]. Some Learning Management Systems are developed for providing an online platform to users for multiple purposes [12]. An LMS is based on multi-instance learning which was introduced by Amelia Zafra et al [13]. To categorize students in LMSs. It mainly focuses on three functions. They are Assignment, Forum, and Quizzes for the students. Ardeshir Bahreininejad and Mahkameh Yaghmaie proposed an effective learning system is based on sequencing and adaptation, Sharable Content Object Reference Model (SCORM), semantic
Web ontology, and multi-agent system [14]. Amidst the pandemic, there have been many successful changes observed in many institutions. For example, The Imperial College in London introduced a class for the science of coronavirus, which is now the most taken class on Coursera this year. Zhejiang University managed to get more than 5,000 courses online in two weeks using "DingTalk ZJU" [9]. A detailed comparison of different LMS is shown above. There are many Learning platforms that provide various purposes. The features of these systems are generally course management, virtual classroom, feedback management, and other common features. However, none of these systems is the unification of learning and gaining information on the area of interest of the users.

2.1. A detailed comparison of different LMS

| Technologies | Features | Platforms and tools |
|--------------|----------|---------------------|
| MS- Visual Studio.Net, MS-SQL Server | Tracking of learning Testing, Registration, Online course material, Delivery, Offline course material, communication. | Not Reported |
| Moodle | Assessment | Moodle |
| Moodle | Moodle features | Moodle |
| Not Reported | Quizzes, Assignment, Forum. | Not Reported |
| C, C++, Java, XML, SOAP | Account Management, Security Protection, Collaborative Learning, Student Activity, Feedback Collection, Online Electronic Experiment. | Pentium IV 2.80GHz, 512MB RAM, Window 2003 Server. |
| Stand-Alone, Web Based, Adaptive hypermedia, Semantic Web | Person and group information, person’s profile and learning history, assessment, groupings of learning content, dynamic content sequencing, learner competencies, learning activities, searching across federated databases, connecting diverse eLearning tools. | Not Reported |
| Not Reported | Not Reported | CSCL tools; Collage and Gridcole. |
| PHP5, MySQL, HTML, Javascript, XHTML, CSS | Carry out Practical, assignments in astronomy, automatic control, chemistry, image processing, robotics and real-time operating systems. | Ciclope software, Apache |
| Not Reported | Face to Face(F2F) Learning over internet, Discussing on forum, studying lessons, solving self-test, creating seminars, course creation, examination, evaluation. | AHyCo Tool |
| Moodle | Student motivation and Interaction patterns. Apache Moodle share education institutes learning object repositories. | Adobe LOP2P Plug-in, Java language with JXTA framework. |
| Not Reported | Course access, video and animation, quiz, virtual classroom. | Adobe Connect Professional, Adobe |
There are many Learning platforms used for different purposes. The features of these systems are generally course management, virtual classroom, feedback management, and other common features. However, none of these systems is the unification of learning and gaining information on the area of interest of the users.

3. Proposed approach
During a crisis like COVID-19, sharing knowledge becomes very much necessary. Today it is extremely easy to share knowledge due to evolution in technology. In this paper, we have explained our approach to an e-learning based learning management system. Keeping in mind the basic parameters such as technology, features, and platform-tools. Based on these parameters a new unified system is proposed with all these parameters and other new features. The main idea is to provide an online user interface, to increase the efficiency of Virtual Learning Management, and to organize e-learning content in one location. We have proposed a learning platform that would work both for e-learning and learning during normal situations. Since there are different modes of learning, we have selected asynchronous learning as our main way of teaching and learning. By doing this we provide both the faculty and students equal time and opportunity to organize a class. The instructor can manage the lectures according to his or her schedule or the timetable set by the organization and the student also has the flexibility to check out the classes anytime. This overrules the problem of network connectivity and time management. Another feature that we have proposed is students can see the number of views of an uploaded course, and by analyzing these views, appropriate suggestions are provided to students taking the courses. Our proposed model also follows the general norms of a basic e-learning platform that is learning end teaching is completely computerized and thus decreases manual power. It does not consume a large amount of time and paperwork. This system has no scope for human contact and hence exceptionally reliable during pandemics and other crisis. Apart from these basic features, we provide a single platform for the users to get to know their associated major more proficiently, by providing them with a lobby area where the alumni and students can post their views, suggestions, and experiences in the industry. We also have included a feature of attendance check-in where the student attendance is taken care of. unlike in the existing system there no single platform for acquiring information on various aspects of different domains and evaluating student performance. Apart from this our approach also proposes flexible searching using Machine Learning. Hence the Outcomes are mainly focused to increase Instructor-Student time and to provide a flexible interface for online learning, which reduces learning and development time. Hence this approach makes learning flexible for the community.
Figure 1. General process flow of the proposed approach.

4. Experimental setup
Web development is undergoing continuous evolution over some time and it is expanding its reach. This advancement has made way for web technologies. Web development is the task of developing dynamic web applications. Two major segments of web development front-end development are the client end and back-end development that is server-end. [15] Front-end development is what a user can see when they load a web application which includes the content, design, and how one can interact with it. This task is performed with the help of three codes mainly HTML, CSS, and JavaScript. Back-end development is the charge to control all the actions that take place behind the scenes of the web application. The back-end development uses a database that will generate front-end [16] [15]. To make a web application, we need to make the server, application, and database communicate with each other, which is done by using server side languages like PHP, Ruby, Python, Java, and .Net, and tools like Oracle, SQL, and MySQL to save, change, or find data and send it back to the user in front-end code these tools are used to create or contribute to web applications with clean, portable, well-documented code. [17] But before writing that code, we need to know the system requirements, then translate those into technical requirements and come up with the most effective and efficient solution for the technology. When a new user accesses our website, he or she can register with our services, and all the credentials of the registered users are stored in our database server. Once the user enters valid details, they either upload or enroll in courses. We have embedded different areas on the website for the flexibility of users using HTML, CSS. If the instructor wants to upload their course and materials, initially they have to select a category from the provided catalog, if the required category is already provided in our service, they can proceed to upload their content, where all the uploads are stored in the database for future accessing. On the other hand, if the student wants to enroll and start learning a course, he can select the category and start learning by enrolling in the course. For making our website reliable, we are using various Machine learning algorithms that can receive the input data and use statistical analysis to predict the output, based upon the type of data available. By using supervised and Unsupervised Machine learning algorithms such as linear regression, clustering, the association we are providing applications such as search engine, user behavior analysis to give personalized recommendations. For example, the content suggestion to the students based on the type of video he or she watches the most and gives personalized recommendations. Using the Machine learning algorithms, we provide a search engine that enables the search option for the students which provides the best results. Also, whatever the page is being opened by the students for a particular topic frequently will remain at the top of the
page for a long time. The architecture of our approach shows the interaction between the user, middleware system, and database to ensure multiple processes work together. With our application, we have a server and client-side, two programs are running simultaneously. The code developed with HTML, CSS, JS which lives in the browser and responds to user input. The code developed using PHP, Python, JS lives on the server which response to the HTTP request. When the user tries to access our web application, through the internet browser, the website lives on and loads the requested page. The server then responds by sending files over the browser, after this action, the browser executes the HTML, CSS, and PHP files to show the requested page to the user. In case of any stored information is to be loaded, the server accesses the database and sends back the required information which is again sent over to the user through the browser.

![Technology ecosystem for the proposed approach.](image)

5. Results and discussion
The digital revolution has resulted in exceptional changes in how and what way the content is accessed, consumed, discussed, and shared. In this proposed paper educational courses are uploaded by the experienced instructors that can be taken up by the students which suit them depending on their availability and comfort. In contrast to classroom teaching, with online-based learning students can access the courses numerous amounts of times. This is especially required at the time of revision when preparing for an exam and unexpected situations, for example, COVID-19 and a similar crisis. In the traditional form of the learning system, if the students cannot attend any lecture, then they must prepare for that topic on their own which might be difficult. In e-learning, students can attend the lectures whenever they want with ease and even during normal times, e-learning platforms can be used along with face-to-face learning for better student-teacher interaction. As compared to the present system, the online learning model has relatively quick delivery cycles. This indicates that the time which is required to learn is reduced to 30%-65% of what is required in the existing system. Some of the reasons why the learning time is reduced with our approach are that students can define their speed of learning instead of following the speed of the whole group. It saves time as the student does not need to travel to the training venue. They can learn at their comfort and in their place. They can also choose to study specific and relevant areas of the learning material without focusing on each area. For example, they can skip a particular area that they do not want to learn. There are also many benefits to online learning. It enables educators to get a higher degree of coverage to communicate their content in a consistent way for their target audience. This makes sure that all learners receive the same type of training. It is also cost-effective as compared to traditional forms of learning. The reason for this reduction is because learning through online mode happens quickly and
very easily. [20] A lot of training time is reduced concerning trainers, travel, course materials, and accommodation.[19] This cost-effectiveness also helps in enhancing the profitability of the organization. [20] Also studying at one’s place relieves paying for travel expenses when training happens in another city, state, or any external learning materials. E-learning is a paperless way of learning; it protects the environment to a lot of extents and hence the highly eco-friendly way of learning. Due to the pandemic the learning was at a halt for few days, this became highly inconvenient for students as well as the administration but thanks to technology, many professional institutions have started developing their own LMS to reflect on the current educational system.

6. Conclusions and Future Work
One of the many questions raised in this research was whether e-Learning and traditional face-to-face learning should be measured based on the same definitions of and approaches to effectiveness during pandemics and another similar crisis. To find appropriate answers to this question, the authors had to consider the identified definitions, measures, and factors when designing for an effective E-learning platform. Whatever e-learning demands, an LMS is there to deliver. Without it, the online world would be a huge textbook filled with unorganized knowledge, there would be very little order to our studying efforts, and even little methodology to help us gain, understand, and retain all the information. Learning would still be possible, of course, but not in an effective, systematic manner that LMS provides [21]. No E-learning platforms can be alike for choosing the best for education. The complex process of teaching and learning requires complex, models of accomplishment. A universal idea behind the selection of LMS is that E-learning is organized and managed within an integrated system. The learning management system normally offers discussion forums, file sharing, management of assignments, lesson plans, syllabus, and other features. A sustained process requires aligning context changes with changes and approaches to learning methods and available technology. The Institutions must adapt, using technologies and models of understanding, with the change in environment and global situations.

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