A Comprehensive Literature Review On The Application Of Devops In Electronic Learning Systems

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Abstract— The main purpose of this research was to explore recent studies on the application of DevOps in E-learning. E-learning has become an essential tool for many people in the current technological environment. The integration of DevOps seeks to provide comprehensive technological training and processes for users. The application of DevOps in E-learning is common in education, marketing, sales, and other electronic sharing operations [1,2]. DevOps environment combines development and operations to make sure there is a quick efficient and continuous workflow of processes. Building an understanding of DevOps best practices is necessary in an E-learning environment [1]. DevOps combines cultural philosophies tools and practices to ensure that applications and created faster and therefore assist organizations in evolving and developing quality products. The main aspect of DevOps is the high velocity when creating applications and services which is faster than the traditional infrastructure and software development processes. Additionally, the high velocity in DevOps helps organizations to compete effectively in the market and serve their end users well [1,2].

Keywords— DevOps, E-learning, continuous integration, DevOps e-learning, velocity, continuous integration, software, automated testing, academics, online learning, higher education

I. INTRODUCTION

DevOps is becoming popular among software developers and the technological industry as a whole. Most industries and academic institutions are now adopting DevOps due to its many benefits in E-learning. Academic institutions are now adopting DevOps in areas like computer science and software engineering. This has been extended into classrooms especially in teaching learners about configuration environments [2]. A good example is in helping learners to develop their projects where they will be needed to send confidential feedback. The personal projects are important to individual students in developing skills and outlining how they complete and submit their issues. Continuous integration (CI) is an important aspect of testing code, especially fact-checking and garde testing answers. Every element of DevOps is needed to develop the course structure and help teachers streamline their teaching and learning process.

DevOps is effective in automating processes and the integration of teams into a seamless working together to improve the completion of various projects. Developing a better philosophy in a team requires trust and collaboration [3]. Some of the common methodologies that ensure the smooth running of DevOps are continuous integration, collaboration, and incident management systems. Once there is collaboration in e-learning, academic institutions can move their courses into virtual learning. This is advantageous to students who want to learn remotely as they can have access to a collaborative classroom environment [3].

Additionally, businesses can develop this aspect of using DevOps to run a virtual business environment. Business experts can rely on DevOps to replace the human element of doing things. DevOps can improve the management and organization of operations. For a very long time, DevOps has become an essential technique for many IT operations for both large and small businesses. DevOps engineers work on technical operations because of their skills through hands-on experience. Senior developers and technologists can gain skills in DevOps, especially in pipeline procedures. For a very long time, DevOps developers have operated in silos due to the lack of collaboration. This has caused tremendous loss to business operations [4]. The lack of interdepartmental cooperation has been the main cause of these challenges. DevOps teams can work on their goals and KPIs by sharing information and expertise to streamline operations and increase their outcomes.

II. RESEARCH PROBLEM

The main problem that will be addressed in this study is to analyze how the integration of DevOps in e-learning works towards improving operations and services. Studies have shown that DevOps is not yet understood and the roles it plays in many academic institutions. This awareness gap is not being closed at the required pace and therefore it affects the adoption in many ways. Higher education is the most affected as many institutions are offering most of the classes on online platforms. This gap will be expected to be closed with more institutions embracing DevOps to increase the collaboration between the departments and bridge the gap between the IT and development teams. One of the surveys reveals that many people in academic institutions are already using DevOps on many tasks and are planning on expanding their roles in various departments. Of the respondents who were surveyed,25% plan on deploying DevOps in the subsequent stages of its life cycle especially the Manage to Defend stage except the Create Stage. Additionally,55% of the respondents revealed that they were already using DevOps [5]. However, more work needs to be done to ensure that DevOps is deployed in many e-learning platforms to ensure seamless collaboration between departments and end users. Students, professors, and staff must fully grasp the roles and elements of DevOps, especially its best practices and coding samples. DevOps can also be beneficial in teaching, especially its integration into e-learning and professional training[6].

III.   LITERATURE REVIEW

This section will explore the meaning of e-learning and the adoption of DevOps in e-learning.

A. E-Learning

E-learning can be described as an educational strategy where academic resources are introduced to online platforms for learners to access using their computers, smartphones, and other electronic equipment [7]. Instructors use many methods to make the resources, especially presentations, documents, videos, simulations, online classes, talks, movies, etc.[7].

E-Learning System Architecture
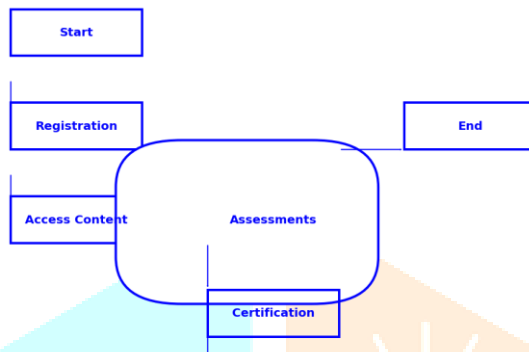

E-Learning Course Flow

Fig i: An E-learning course flow

E-learning can either be synchronous or self-paced depending on the versatility a professor wants it to be for the learners. Professors can easily modify their learning programs in line with the goals and demands of their learners and trainees. DevOps ensures that the classes are delivered in a speedy way and on a large scale.[6,7]. E-learning is different from conventional methods of learning since it allows professors and trainers to apply tools and platforms such as e-learning systems. These platforms are very efficient in enhancing human interaction between the learner and their tutors. This allows them to increase their engagement and monitor their learners' progress in the courses they have taken. Corporations have also adopted E-learning to train their employees in various programs like leadership and soft skills. This makes it easy for corporations to train many employees at a time and improves engagement during training [8].

B. e-Learning System

An e-learning system can be described as an online platform that has been established with resources to provide trainees and learners with educational content [7]. This platform has many resources made available in various methods including presentations, documents, videos, simulations, interactive quizzes, online classes, talks, movies, etc. [7]. E-learning systems are beneficial in providing seamless learning on different courses and topics to the learners. Learners can select the courses they want to take at a time or follow the school program to meet the demands of their academic or training goals. They can also acquire their skill sets at their own pace or choose the time they want to take these courses and topics[8]. With the advancing technology, anyone can take e-learning courses given the contemporary rapidly changing and distributed learning environments.
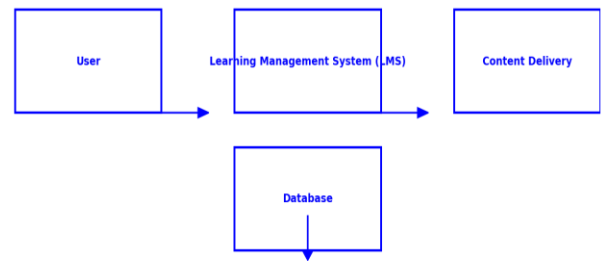
Fig ii: An illustration of an E-learning System

C. Systems That Are Used In E-Learning

Many e-learning systems can be used by learners and trainees in various sectors. These will be discussed as follows:

1. Microlearning

Microlearning is an e-learning method where teaching and learning are made available on online platforms in manageable topics or in small portions [8]. These lessons are made in small portions to allow learners to absorb them faster. Many learners may not be able to process large material per course session. Splitting these courses and topics into smaller portions increases the absorption of these courses. Microlearning is becoming a key component in e-learning as a result of its effectiveness over traditional training. Microlearning is effective in business training, retail, and other general training programs [8].

2. Electronic Learning System Templates

Electronic learning systems comprise templates on their platforms. The application of e-learning has many advantages. One can choose from several templates on the best e-learning platforms instead of the traditional true or false questions [8,9]. Trainers can interact and respond to a range of questions and gain more experience in answering them. They can also use word searches to look for information easily. Other options are the use of scratch-to-reveal quizzes, and swipe-right lessons among others [9]. Professors can include other components of micro lessons that can allow more interactive learning. Some of the common programs that can improve interactive learning revolve around leadership, solving puzzles, math exercises, and gaming quizzes.

3. Cloud-based Learning

Cloud platforms have become popular in the current technological environment. Cloud-based learning is beneficial in areas where broadband infrastructure is unavailable or poor in connectivity. Organizations can make their course materials available through cloud-based connectivity in such locations [9]. Cloud-based platforms make the management and upgrade of content easy. One can effortlessly manage and modify their courses at any time while the learners have full access to the updated material on the platform at any time.

4. Mobile-First Learning

Mobile-first learning is an educational approach where educational content is delivered using smartphones and tablets. This approach facilitates learning experiences by leveraging the features of mobile devices to offer effective learning opportunities. This is advantageous and convenient for learners and trainees in an office setting. They can juggle between their work responsibilities and upgrading their skills at their convenient time [9]. Some of its key features include a responsive design, micro-learning, increased engagement, flexibility, and multimedia integration.

D. DevOps Model

The DevOps Model ensures that development and operations in any system are no longer siloed like the traditional models. In most cases, DevOps components are merged into one to make sure that engineers work seamlessly in their software development cycle. This is from the development cycle to running many application tests and its final deployment. Engineers must have many DevOps skills to deal with diverse roles and the ability to handle various operations. The application lifecycle usually integrates quality assurance and security teams in many DevOps models. DevOps teams usually focus on security in their development often referred to as DevSecOps. Most of the DevOps teams have been utilizing various practices in automating the processes that have often been manual and slow.

DevOps tools help engineers to operate and advance the applications at a reliable and faster rate. Most of the tools utilized are efficient in accomplishing tasks especially when deploying code and provisioning infrastructure. This helps in listening to the work that would have needed more teams because it increases a team's velocity [9,10].
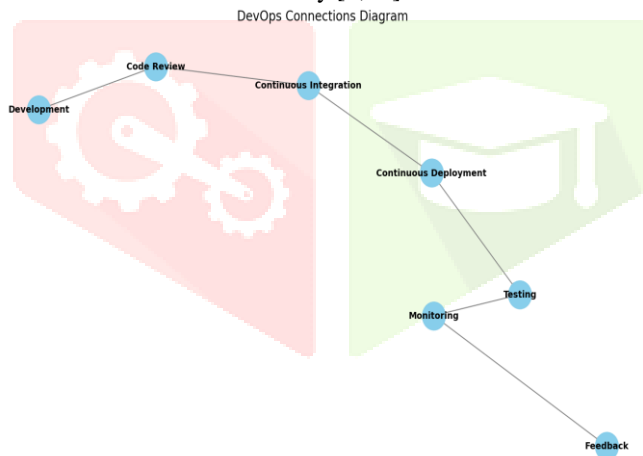

Fig iii: Stages and practices in the DevOps pipeline

E. Integration of DevOps in E-learning

DevOps has a tremendous benefit to many e-learning platforms owing to its popular features. The adoption of DevOps allows for efficient workflows, advanced technology, and operations in e-learning platforms. Many academic institutions will benefit from DevOps if fully and properly integrated into e-learning platforms. All the DevOps stakeholders must be familiar with its functions and how it can be integrated into various platforms like e-learning. They should also be effective in installation and its initial application.

DevOps models are proving to be a much-needed tool in higher education in many areas. Students can increase their learning preparation and contribute to their skills which is much needed in the market to get employment [10]. This contributes

to employees who are ready to work with the skills they have acquired in their training [10].

Instructors and professors can now integrate DevOps in teaching learners on code. What they use is source code management with git rather than the traditional learning management systems. SCM gives the professors the freedom to create and edit code [11]. Additionally, learners can now collaborate and work as a team in coding and learning how to test and deploy their programs. The automation of processes using DevOps has enabled faculties to grade learners in real-time and give them feedback on areas to improve their competencies [11].
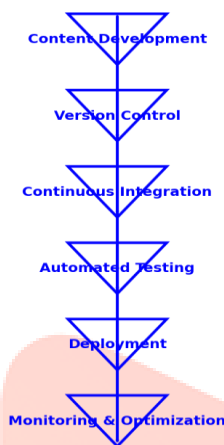

Fig iv: A process of integrating DevOps in E-learning.

IV. SIGNIFICANCE AND BENEFITS

DevOps has proven to be effective in e-learning, especially for academic institutions and corporate environments. DevOps has proven to be effective in making the workflows more efficient and seamlessly running operations. Higher institutions are gaining a lot from the integration of DevOps in their learning environments. Professors can now teach and help students in running tests on their code. They can also run the installation and release of applications faster than traditional practices. DevOps best practices of high velocity contribute immensely to the increased efficiency of software development and operations[14,15]. Businesses need to increase their operations and the working efficiency of their teams. E-learning is proving to be effective in collecting data for prediction of various aspects of their businesses. The integration of DevOps allows employees to work as a team to meet the deadlines of various projects.DevOps introduces a culture of collaboration to achieve the set goals and outcomes. The traditional manual practices have been eliminated by DevOp's best practices by reducing the considerable time needed to execute, report, and monitor projects. Stakeholders are utilizing DevOps tools to construct standard pipelines, especially in implementing software.

V. FUTURE

The future of E-learning will see more integration of DevOps in learning and training many people. This is already being done in classrooms and businesses, but more progress is expected in the future. It is expected that DeVops will increase the employability of graduates and job applicants as more students will earn the requisite skill sets for various industries. There should be a lot of awareness and knowledge of the best practices and the new experiences brought by DevOps [19,20].

DevOps integration needs to be made a constant influence on the already stimulated education industry. Its benefits will expand workforce development and increase the competencies in the corporate sector [19]. DevOps will change the culture of classroom learning into a more collaborative one. This will accelerate the digital transformation in the classroom and increase the benefits to the digital world in terms of innovation and competencies of employees.

V.   CONCLUSION

The main aim of this paper was to explore the integration of DevOps in e-learning. The findings show that DevOps is gaining a lot of popularity in the education and corporate world. It is increasing the efficiency of workflows and digital learning by creating a seamless learning process. One of the significant areas of contributions in e-learning is the automation of processes and revolutionizing the systems run by various institutions. Additionally, DevOps has become the mainstream tool breaking boundaries between e-learning development and operations. Organizations can take advantage of DevOps practices to resolve the many challenges they face in terms of making their operations agile. DevOps also can improve communication and collaboration due to its automation and tooling aspects. Organizations can apply these aspects in their software delivery processes to bring together workflows. This also enables a physical combination of responsibilities of DevOps to set a strong culture between teams. A team with strong cultural norms can facilitate communication and information sharing efficiently. They can use chat applications and wikis in communication and sharing of information to run the operations. This is also important in ensuring that information across developers is faster and more efficient tracking of projects.

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