MJIT 2024 Malaysian Journal of Industrial Technology

THE IMPORTANCE OF USING CLOUD COMPUTING SERVICES AND TECHNOLOGIES IN TRACKING STUDENTS' BEHAVIOR WHILE USING ASYNCHRONOUS E-LEARNING PLATFORMS

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ARTICLE INFO

Handling Editor: Rahimah Mahat

Article History:
Received 31 August 2024
Received in revised form 19 September 2024
Accepted 13 November 2024
Available online 1 December 2024

Keywords: Asynchronous e-learning, cloud computing, Principal Component Analysis (PCA), Analysis of Variance (ANOVA)

ABSTRACT

Abstract: The problems that different aspects of teaching and learning provide to the education industry are continuous. Teachers and students together always struggle to increase their knowledge due to ongoing technological breakthroughs in education. In order to remain on track and maintain students' engagement during the COVID-19 epidemic, several educational institutions were compelled to quickly implement such technologies. Students that participate in asynchronous e-learning are by themselves throughout the process of learning. The main effects of this loneliness are dissatisfaction and lack of motivation, which increase the dropout rate. Monitoring a student's behavior while they are learning enables timely intervention. However, the amount of information offered to teachers in the online courses could be excessive. This study has shown the impact of cloud computing and its function in tracking students' behavior throughout the asynchronous e-learning process. We compile student data and perform a questionnaire survey on the relevance of the cloud in asynchronous e-learning. To simplify the components and improve the outcomes, Principal Component Analysis (PCA) was applied. The findings are analyzed using descriptive statistical analysis and Analysis of Variance (ANOVA). The research demonstrates how technology use and improved internet infrastructure have a significant positive influence on learning, enabling studying at anytime and anyplace.

1. INTRODUCTION

The term "cloud computing" refers to the process of providing a service via remote servers and client software (typically the Internet). Users may access their data and run their programs from any Internet-connected device thanks to cloud computing. Gmail, from Google, is one service that uses Cloud Computing. A simple definition of cloud computing is a system that may be immediately given and distributed with little administrative work or interaction between the service provider and the customer [1]. Due to the rapid development of information and communication technology, cloud computing has become an extremely common service.

Clouds are distributed systems of computing and data storage that use many technologies to pool and control access to shared computing resources [2].

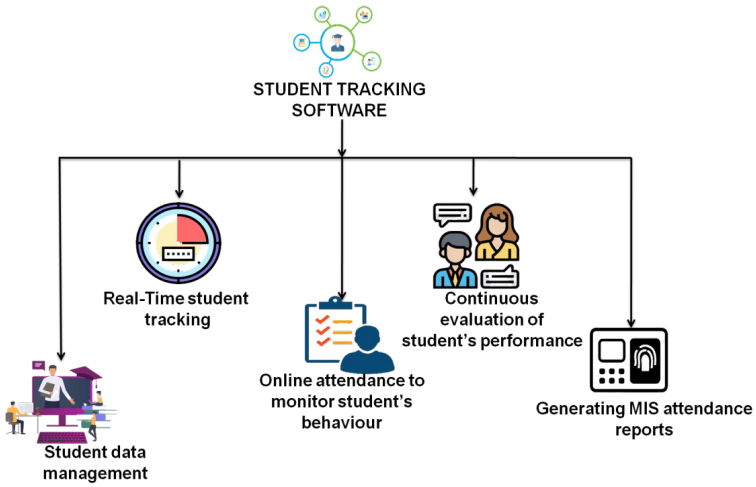

Figure 1: General structure of student tracking software

Figure 1 depicts the general structure of student tracking software. A recent survey confirmed that many students favor using social media as a means of education, information exchange, and communication. As a result, more forms of media are being put to use in online education. Based on their research findings, they suggest using social media to create and disseminate instructional materials that utilize several media types. Besides boosting students' self-assurance, their research found that these methods also helped keep them motivated. There are several potential advantages to using cloud computing in the academic world. It can assist improve software-related services and let students use cloud-based hardware and applications rather than buying and installing costly local copies on their own computers. Keeping everything running well requires little work from the school's IT department [3]. One of the most cost-effective, time-efficient, innovative, and cutting-edge methods of education today is through the use for asynchronous e-learning. In light of the need to enhance the educational opportunities available to students in remote locations, this study is asynchronous E-learning expert system tailored for higher education institutions. As it is prohibitively expensive to set up the necessary infrastructure for students and teachers/lecturers, this asynchronous E-learning module has moved to the cloud. The budgetary needs of cloud infrastructure are analyzed so that they may be incorporated into the overall plan for funding higher education. Syllabus, course, and study material design are only a few of the many academic procedures unique to higher education that are challenging to manage using more conventional teaching methods. With a centralized cloud-based system, however, these processes may be made

available to all parties involved in the system with no effort [4]. As asynchronous conferencing technologies are time-dependent, asynchronous online communication takes place in a time-independent setting. Learning is possible online asynchronously, regardless of time, location, or pace. Students finding themselves completely alone in their learning process are one of the drawbacks of asynchronous online learning. This sense of isolation causes irritation and a lack of drive, which contributes to a high dropout rate. More importantly, a student cannot be monitored to determine whether they are losing interest or not participating in the online learning session, the lack of personalized monitoring is a constant source of concern. When tracking student involvement, Asynchronous e-learning systems could be made better by allowing for targeted interventions to reengage students when necessary. When students are engaged in their learning, they devote time, effort, thought, and, to some extent, sentiments to it. Online course enrollment is typically lower than in-person enrollment. Poor student participation puts both the students' instructor and themselves in danger. Engagement is essential for effective asynchronous e-learning. The interaction a student has with online content while using an asynchronous learning tool can be used to determine their level of engagement. The automatic detection of student engagement can also be done by using face traits [5]. Hence, we suggested that cloud computing could have an effect and serve a useful purpose in monitoring student behaviors all through their asynchronous e-learning session.

Contributions

- 53 first-year undergraduate students' dataset were gathered from the basic computer science course for asynchronous online learning.
- Cloud computing helps academic protect student as well as personal data in asynchronous e-learning platform.
- Principal Component Analysis (PCA) was used to reduce the number of variables and produce more accurate data.
- Analysis of Variance (ANOVA) and Descriptive Statistics are used to analyze the data.

2. PROBLEM STATEMENT

Asynchronous e-learning implementation, adoption, and use are still limited and can be viewed as a failure in many of the countries, despite the initiatives taken by developing nations to integrate it into their educational systems in order to improve access to higher education and offer a flexible mode of learning. Many academics have noted that poor e-learning system

quality is closely related to the failure to successfully develop, adopt, and employ asynchronous e-learning. Institutions made efforts to utilize these information systems, high institutions of education should first determine the factors that influence quality and then use those factors to enhance systems. The research prepared a questionnaire in an attempt to tackle the issue of the gender imbalance in educational achievement between students participating in synchronous and asynchronous learning. It is the responsibility of the government and university administration to provide the required information and communication technology (ICT) and related facilities to support asynchronous online teaching and learning across all institutions of higher education. Developers and designers of national curricula should make sure that distant and asynchronous online learning are appropriately integrated and made flexible to maximize their effectiveness in providing high-quality education. Effective instructional delivery may be facilitated by ensuring that teachers and instructors of distance and other relevant asynchronous online learning have enough training in the right use of asynchronous online facilities. Teachers should be urged to avoid using any kind of gender prejudice in achieving their pedagogical goals with their students. Teaching students to take their studies seriously is important because it may have a positive impact on their academic performance whether or not they are under direct teacher supervision.

3. AIM AND OBJECTIVE

To this research indicate the significance of cloud computing and its role in tracking students' behavior via asynchronous e-learning. We collect data from students and administer a survey to determine how important the cloud will be for online education in the future.

4. RESEARCH QUESTIONS

In contrast, if these processes are unified via a single cloud-based system, they will be readily available to all parties involved. This study was undertaken to investigate the following question.

1. To what extent can we design a framework that effectively enables the detection and recognition of users' students' behavior in a Cloud computing context?
2. Uploads and downloads in the cloud is?
3. What are the sources of data for emerging cloud computing architectures?
4. To what extent has asynchronous E-learning been applied in emerging cloud computing architectures?

5. Which type of cloud is good for educational institution explain with an example?
6. Do students use cloud computing?
7. How is the usage of existing asynchronous e-learning systems in private higher education institutions?
8. How is the adoption of cloud in asynchronous e-learning systems in private academic sector?

5. RELATED WORKS

This paper reviews several research papers and technical reports authored by diverse writers. Study [6] explored the importance, relevance, and necessity for Cloud Based E-Learning (CBEL) at Oman's HEIs. The data analysis methodologies helped analyze and gain useful insights on adopting CBEL in education. Oman's educational system is developing; hence there is less knowledge with CBEL difficulties and hazards. According to the research, [7] discussed systematic method was developed to evaluate college students' asynchronous online learning engagement, tenacity, and influence on academic success. Data validated all hypotheses except one concerning asynchronous learning persistence and academic improvements. The many college students engage in non-academic activity during lectures, asynchronous one of e-challenges learning's. Study [8] explored asynchronous e-learning at Jordan's Princess Sumaya University. The flipped classroom method helped Electronics II overcome asynchronous e-learning issues and maintain performance. Higher education management and theory are affected. Early remarks were more afraid than unfavorable. The research [9] discussed that Malaysian postgraduate medical physics asynchronous e-learning during the COVID-19 epidemic. When students favored face-to-face education, they adapted to asynchronous e-learning. Asynchronous E-learning and home-study provide flexibility. Students have trouble focusing due to interruptions, disinterest, and tension. Poor Internet access and restricted data plans exacerbated the issue. The research [10] focused on technology available to assist teaching and learning in asynchronous e-Learning systems, which are important for educators and system developers. They analyze asynchronous e-Learning system technologies and their use, prospects, and development trends. A complete analysis of development concerns in asynchronous e-Learning focused on influencing variables. Study [11] analyzed a “Secure E-learning System (SES)” for exchanging exam-related content while avoiding security assaults. The proposed SES lessens the percentage of untrustworthy students, the amount of test results that are made public, the amount of time students spend actively engaged in class, the difficulty of verification, the reputation of the institution, and the lack of trust in the institution. A

growing development concerns in asynchronous e-Learning focused on factors influencing these developments. The study [12] clearly described the concepts related to agents and multi-agent systems in asynchronous e-learning, and it also analyses the literature on the development of multi systems in asynchronous e-learning with an emphasis on the various agents. Each agent has limited knowledge and abilities to address the world problem. The study [13] determined online banking consumers' satisfaction. Online banking may enhance consumer happiness via cloud services, security, asynchronous e-learning, and service quality. Cloud services, security, e-learning, and service quality influence Internet banking consumer happiness. The e-banking sector's biggest challenge is meeting the requirements of an increasing number of online customers. The research [14] attacks against cloud computers used in asynchronous e-learning have been researched and classified by victim using an inductive methodology based on worldwide cyber attack statistics and recent research. And provide measures to prevent its recurrence and protect computer clouds. This systems approach evaluates online student behavior to increase student engagement and online activity design. It's key to understanding internet user behavior. Study [15] used the metadata method and the Community of Inquiry Model; they develop a conceptual model for profiling student behavior in online courses. With the intention of bettering student engagement and online activity design, this conceptual model serves as a foundation for assessing the features of online learners' actions. This is a first-order concern for any analysis of online behavior. The research [16] evaluated Portuguese teachers' attitudes on classroom management, the relationship between self-off and teacher efficacy, and teachers' perceptions of classroom behavior time. Use mediator and moderator variables on cloud classroom management as well as English teachers' cheating perceptions. Human vision surveillance and accurate people counting are vital.

6. PROPOSED METHODOLOGY

Asynchronous sessions operate on a more flexible schedule, with students having access to course materials at various times and from various locations. Everybody in the education benefits from using the cloud. With cloud computing, students can access their assignments from any device with an internet connection, teachers can submit lesson plans in real time, and administrators can share files conveniently and save money on data storage. Figure 2 illustrate the methodology of the flow work.

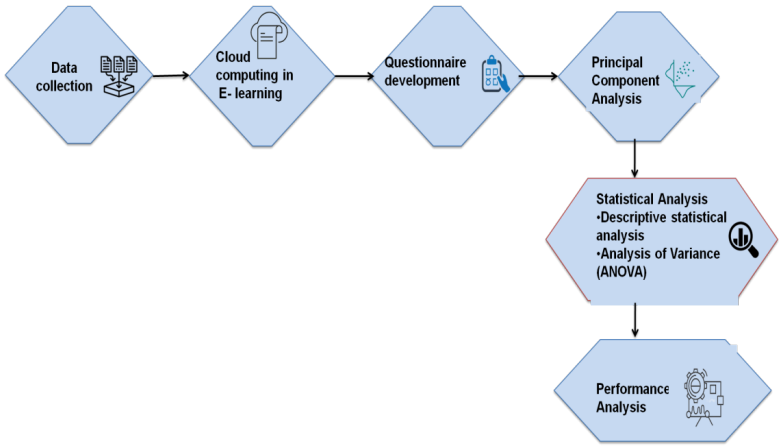

Figure 2: Methodology of the flow work

6.1 Data collection

In the survey, 53 first-year undergraduate students enrolled in basic computer science course volunteered to participate in e-learning. The computer science course is an e-learning course that meets once a week for synchronous face-to-face instruction and once for asynchronous online learning. The length of each video lecture in an e-learning session is approximately 11 minutes. While students were watching the video lectures, data for this study was being gathered. We asked the participants to attend the asynchronous e-learning sessions in an experiment room. As a result, some students were unable to participate in the experiment during some sessions [17].

6.2 Cloud computing in E-learning

The term "cloud computing" refers to a relatively new kind of data processing in which virtualized, scalable resources are provided to users via the Internet. To put it simply, "the cloud" is a group of interconnected servers. These interconnected PCs might be found in either government or business institutions. With cloud computing, you can build and maintain your IT without investing in pricey hardware or software, computer and technology services accessible over the Internet. Accessing computer resources like program software requires the usage of an external Internet service. Asynchronous learning in the cloud necessitates a constant and reliable connection. Online retail giants like “Google, Amazon, Microsoft, Yahoo!, etc.,” contribute to school systems. The following is what cloud users expect from their service providers:

Anything-as-a-Service (XAAS): Collective name for anywhere-service delivery. Infrastructure-as-a-Service (IaaS) provides operating systems, networks, and virtual computers, "e.g., Google Compute Engine, Amazon EC2, and Rack space".

Platform-as-a-Service (PaaS): In cloud computing, PaaS is a methodology for executing applications without user-side hardware and software infrastructure, e.g., Google App Engine, Windows Azure, and Force.com. Cloud-based E-Learning

Software-as-a-Service (SaaS): Users can request application software. Google Apps, WhatsApp, and Microsoft Office 365 handle application installation, setup, and operation for users.

Storage-as-a-Service (SaaS): Most cloud service providers, such as Mozy, Google Drive, and Dropbox, offer storage for structured and unstructured data in cloud computing.

Network-as-a-Service (NaaS): In cloud computing, customers or businesses pay per usage or monthly for network services over the Internet.

A user's service selection(s) can be singular or plural, depending on their requirements. In comparison to on-premises solutions, cloud-based asynchronous e-learning services have lower initial investment costs, greater operational simplicity, and more compatibility options for its customers. The cloud's lack of defined security is cause for concern. Asynchronous E-learning, based on the principles of cognitive science, is an outstanding choice for students looking to make use of electronic educational technologies to enhance their multimedia learning. Asynchronous E-learning is a quick and effective method of learning that is both user-friendly and financially beneficial for businesses. Cloud-based asynchronous e-learning is depicted in Figure 3. Directly and positively, asynchronous e-learning has many consequences on students.

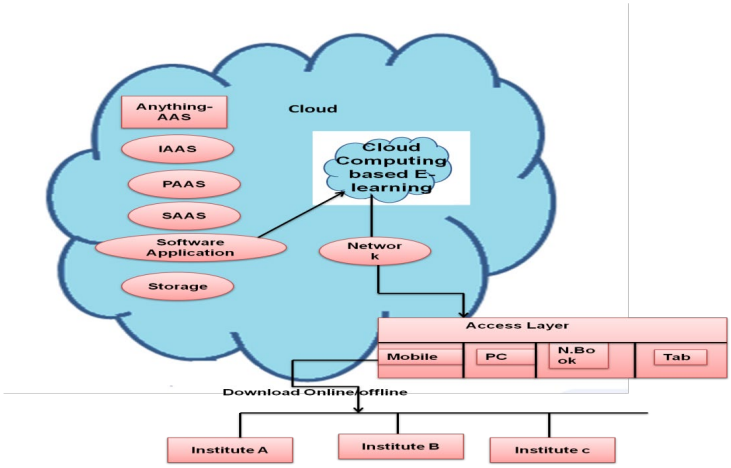

Figure 3: Cloud computing-based E-learning

- There has been an increase in the student-to-teacher ratio on a worldwide scale.
- It's meant to be a simple aid for students as they study a given course or software.
- It boosted memory capacity for new material and aided in recalling previously learned material.
- There is no need to pay for transportation while away.

The demand for online education is continuously on the rise, and there is no sign that it will abate in the coming years.

6.3 Questionnaire development

This study was carried out on the basis of the major factors depicted from a survey that consisted of 8 questions and was carried out in their entirety. The questionnaire was utilized, and the link to it was distributed to the students as well as the teachers at a variety of educational establishments. Because the questionnaire was taken from an article that was freely available online, neither the reliability nor the validity of the questionnaire was tested.

5.4 Principal component analysis

Principal Component Analysis (PCA) to reduce the attributes and see the components. Further, educational tool was used to optimize the PCA using cloud computing approach.

After averaging the data, PCA was used to explore the curve's underlying attributes. Principal component analysis was used to transform a large number of variables into fewer variables that accounted for the most variability. The math answer was similar to finding the eigen value, and the other variables were functional major components. The studied equation contained data on

multiple variables at many time points. If time was the independent variable in the functional context, the work faced dimensionality challenges. Functional PCA can reduce a problem's dimensions. PCA was used to predict traffic flow patterns, which prevented similar functional aspects as EV charging. In y_k *(r)(rT)* was compared to *y(kl)* for different variables (1).

$$g_k = \int \beta(r) y_l(r) = \int \beta y_k$$

Where,$\beta(r)$ = Weight value.

6.4 Descriptive statistical analysis

Descriptive Analysis is the type of analysis of data that helps describe, show or summarize data points in a constructive way such that patterns might emerge that fulfills every condition of the data. It is one of the most important steps for conducting statistical data analysis. In the survey, 53 first-year college students who were enrolled in an intensive computer science course offered to participate in the survey about asynchronous online courses. In order to keep the information balance, we removed all of the students' data who only attended one lecture during the experiment and had missing data. The final valid data, which was obtained, came from 48 students.

7. ANOVA

ANOVA tests proportionality and dependability. For data analysis, students utilized. Questionnaires, IT expert interviews, and case study analysis are the key research approaches. The debate helps address cloud computing characteristics in asynchronous e-learning. The structured questionnaire asked about research-related issues. This research technique allows the team to see emotions and memories related with technology firsthand. Participants will have substantial exposure with technology and insecurity. These breaches help modernize these concerns. Anonymous questionnaires solve discussion's flaws. Developing an anonymous questionnaire where respondents answer questions without identifying themselves can assist get concrete knowledge about sensitive industry topics. An employee may fear mentioning that the organization is trying to fix a security loophole. The questionnaire would give the employee the guts to answer these questions. All materials need peer review. This method examines all security concerns without focusing on one location or industry. Although most questionnaire and conversation material is qualitative, statistical and empirical analysis must be applied. Mode and average of participants describing industry insecurity or the percentage who think firms should invest in cloud storage systems should be numbered. Individual-based

interpretative techniques extract and represent information. The results are human and objective. Anonymity provides more privacy. Subjects are discussed verbally and nonverbally.

8. RESULTS AND DISCUSSION

In this paper, we suggested cloud computing role in tracking students' behavior based on the asynchronous e-learning. Simulation results show the suggested methodology improves the research outcomes in every relevant statistic. Internet usage for students, average time spending of the students on the internet, usage and impact of learning material and intended future use of cloud for the students, its measure system efficiency.

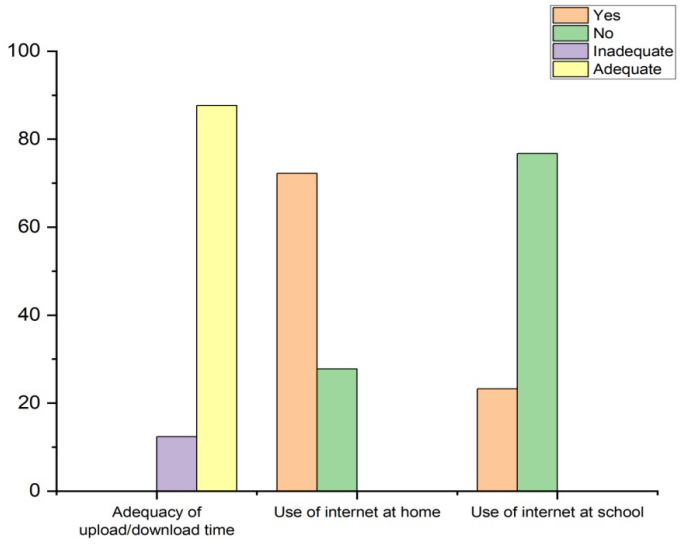

Figure 4: Internet usage for students

Figure 4 depicts the internet usage for students. According to a survey about the quality of schools' fundamental infrastructure, student and teacher amenities, just 23.25 percent of schools had computer labs. There are roughly 73% of students whose homes have internet access. While access to the internet is extremely limited in Indian schools, students are making up the difference with access at home. What's more, 48% of students report spending between one and three hours online every day.

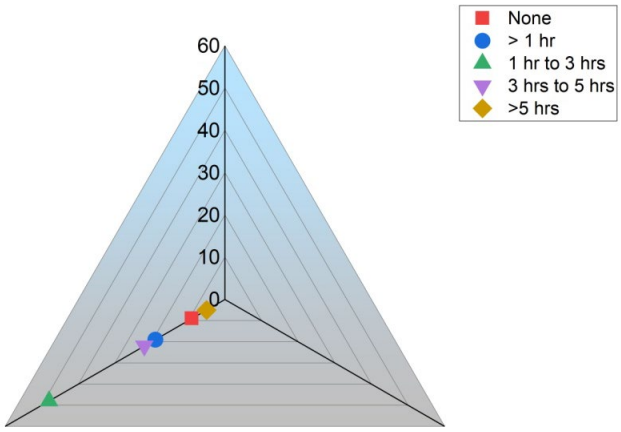

Figure 5: Average time spending of the internet

Figure 5 shows that the average time spending of the internet. In addition, 88% of students agree that the speeds at which data may be sent to and from the internet meet their requirements. Additionally, 48% of students report spending 1-3 hours daily online. This indicates the students' strong interest in interacting with asynchronous e-learning websites.

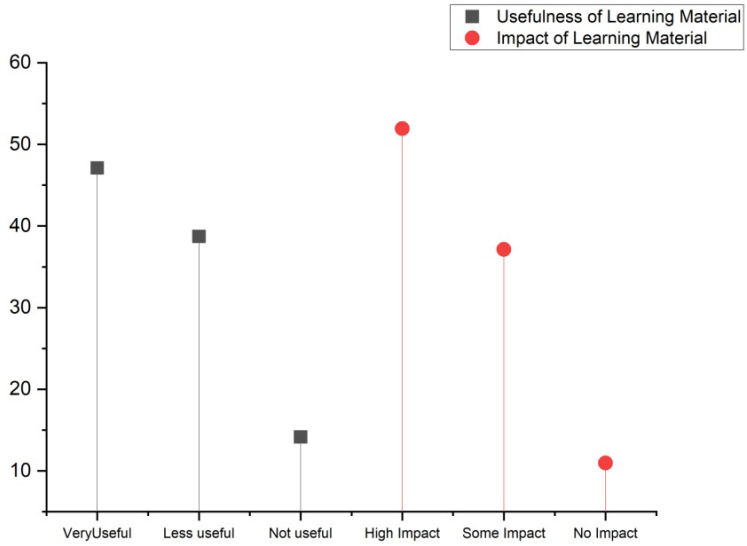

Figure 6: Use and impact of E-leaning material

Figure 6 displays the use and impact of E-leaning material. Nearly half of all students (47%) find the content they receive from the internet to be either extremely or somewhat helpful in their studies. But only 15% of students think the online course materials they've downloaded are useless. And while just 15% of students expressed worry about the value of the downloaded information, 85% of students found the asynchronous e-learning materials to be either extremely useful or useful. Given this, it can be concluded that educational resources available

online are valuable. Not only that, but almost 52% of responding students anticipate the very high impact of the asynchronous e-learning material from the internet, and 37% find the information having a strong impact on the learning abilities. One in eight students, however, reports that the course materials had no noticeable effect on their ability to learn.

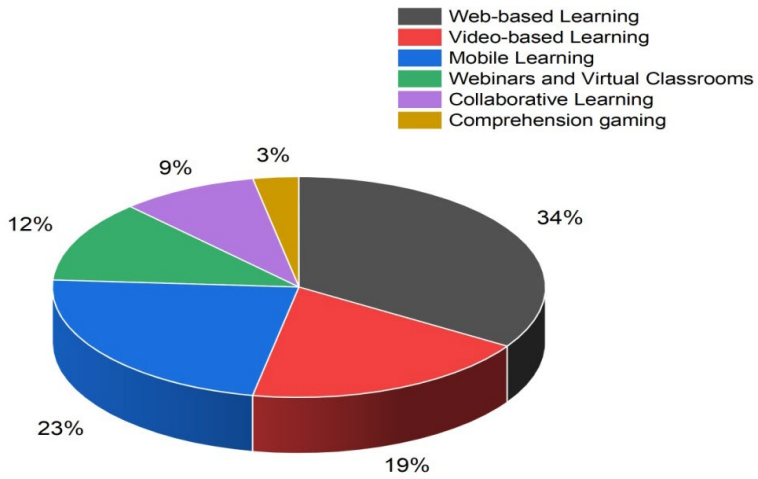

Figure 7: Intended future use of cloud

Figure 7 depicts the intended future use of cloud. In the future, 34% of students would want to learn through the internet, while 23% would like to do it on their mobile devices. While just 12% of students expressed interest in webinars and virtual classrooms, 19% expressed interest in having an interactive video-based asynchronous e-learning environment. This indicates that learners want more educational materials to be made available online so that they can access them regardless of time or location.

9. CONCLUSION

In this research, we suggest the influence of cloud computing and its role in tracking students conduct throughout asynchronous e-learning. We gather student data and survey the cloud's importance in asynchronous e-learning. PCA was used to simplify components and improve the data outcomes. Results are examined using descriptive statistics and ANOVA. Results from the experiments showed that the suggested technique achieves the best performance in terms of internet usage for students, average time spending of the students on the internet, usage and impact of learning material and intended future use of cloud for the students. Asynchronous E-learning software, platform, and infrastructure can benefit from cloud computing, reducing costs. Asynchronous E-learning apps run on the provider's infrastructure, therefore qualified technicians and high-end PCs are unnecessary. There are

study limitations. First, this study only uses a cross-sectional strategy to capture cause-and-effect data, even though the model is explanatory. Second, time and cost conditions limited data collection to a single location. Future studies will improve analyze cloud security and user pleasure. Cloud computing services evaluation is a valuable for tracking student's behaviour and attractive research topic.

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