

The Usage of Open-Source Applications in Teaching and Learning of Computing Courses in the Institutions of Higher Learning

Daniel Njeru
School of ICT, Media and
Engineering.
Zetech University
Ruiru, Kenya

Hellen Nyambura
School of ICT, Media and
Engineering
Zetech University
Ruiru, Kenya

Boniface Mwangi
School of ICT, Media and
Engineering
Zetech University
Ruiru, Kenya

Abstract: Open Source Application is a concept of software development rather than a specific type of application. Information sharing is encouraged through open source software, which is seen as a strong and advantageous idea. The purpose of the study was to determine the impact of open source applications usage in teaching and learning of Computing Courses in the Institution of Higher Learning as well investigating the kinds of open source software's and accessibility that potential computing educators in the area under study are familiar with. The importance of this study, which examined Zetech University prospective computing teachers' use of open-source software in higher education, will give the university's administration and various departments inside knowledge of how familiar and knowledgeable these individuals are with open source software. By doing this, the authority will be able to identify their weaknesses and opportunities for improvement, such as Universities should replace proprietary software with open-source software to reap future benefits like license renewal and file upgrades. In the investigation, a mixed method approach was used. 180 staff members and students were purposefully chosen at random for the study at Zetech University, and a sample of 118 was taken. In the quantitative approach, the descriptive statistics were employed to display the distribution of scores using a few indices. Based on the findings 90.7% were familiar with open source software's while 9.3% were not familiar. 98.3% suggested that it was essential to use open source applications in teaching computing courses while 1.7% rejected the narrative. 71.2 % of the respondents were familiar with universities using open source software's in their Curriculums while 28% were not familiar with any. 46.6% of the respondents ascertained that the university has provided an environment to access open source applications, 31.4% disagreed, while 14.4% were neutral. Universities should switch to open source software instead of proprietary software to save money on license renewal and upgrade fees, a position that was strongly supported by 38.1%, agreed by 40.7%, was neutral by 12.7%, and disagreed by 5.1% and 3.4%. The paradigm for education must change to Education 4.0 in order to give innovatively productive education. Faculty members and educators can employ a range of cutting-edge tools and technology to do this. These technologies can be used to track students' participation and engagement in the program both on and off campus with the help of IoT and ontology. Virtual learning environments can also be utilized in conjunction with different blended learning environments to accommodate a range of learner types. Practitioners must be aware of the potential negative effects of using open source software while developing a product in order to be ready for them, anticipate them, and take the required steps to overcome them. The institutions ought to be linked to websites which features a list of open source programs associated with many categories, including security, cloud computing, small enterprises, big data, games, etc. Aspiring computer science teachers' knowledge of open source programs will be improved as a result. This will enhance the open source software understanding of aspiring computer science teachers.

Keywords: *Open Source, E-learning Platforms, Courses, Computing, Education*

1.0 INTRODUCTION

Open-Source A type of application is one in which the original source code is made publicly accessible for people to view, edit, utilize, and develop computer programs. Linux is one of the most well-known instances of an open source application and is frequently used as a substitute for expensive operating system (OS) programs. A license to use, alter, and redistribute the code is included in an open source application. Open source applications can be used to create goods that are sold commercially. Open Source Application is a concept of software development rather than a specific type of application. Information sharing is encouraged through open source software, which is seen as a strong and advantageous

idea. An unbiased evaluation of popular open source software (OSS) products, most of which are created by unpaid volunteers, frequently reveals that they are of a higher caliber than the software produced by some of the most well-known companies, which unquestionably employ highly intelligent individuals. Every member of the community contributes to the so-called "collective open source knowledge" by coming up with fresh concepts, creating innovative features, offering test data, and recording deployments. The importance of this study, which examined Zetech University prospective computing teachers' use of open-source software in higher education, will give the university's administration and various departments inside knowledge of how familiar and

knowledgeable these individuals are with open source software. By doing this, the authority will be able to identify their weaknesses and opportunities for improvement, such as Universities should replace proprietary software with open-source software to reap future benefits like license renewal and file upgrades. Seminars about the use and advantages of open-source software should be held. This study will assist aspiring computing teachers in realizing that open source software is more affordable than proprietary software, is of higher quality (i.e., has fewer errors and more features), and is easier to access, use, and distinguish from pirated software, proprietary software, and open source software. Finally, it adds to the body of knowledge in computing and acted as a springboard for other, unfinished study.

The study was guided by the following objectives:

- a) To determine the impact of open source applications usage in teaching and learning of Computing Courses in the Institution of Higher Learning
- b) To investigate the kinds of open source software's and accessibility that potential computing educators in the area under study are familiar with.

Research Questions

- a) What is the impact of open source applications in teaching and learning of Computing Courses in the Institution of Higher Learning?
- b) What are the kinds of open source software's and accessibility that potential computing educators in the area under study are familiar with?

2.0 LITERATURE REVIEW

2.1 Types of open source applications for teaching & learning of computer courses.

The most commonly used open source application is Moodle. Online learning management systems built on the Moodle platform have long supported classroom instruction. Martin Dougiamas, a WebCT administrator at Curtin University of Technology, began work on Moodle in 1999, according to its history (Kats, 2010). This platform is fully functional, adaptable, and extensively used by colleges worldwide. According to Cole & Foster (2007), Moodle is utilized by more than 30,000 educational institutions worldwide, including those in Hong Kong and other Asian nations (Luk et al., 2018). Technology and student learning needs can be

combined through e-learning, according to De Clunie et al. (2013). Additionally, it was stated that planning in the learning management system must consider performance expectations, effort expectations, social effects, and facilities (Ramllah & Nurkhin, 2020). These expectations are established in an organized plan that controls the order, techniques, and resources for learning. As a result, they will be prepared to follow the lesson in every class. Based on this idea, Moodle-based learning planning can be evaluated using the following criteria: 1) posting the semester learning plan online; 2) explaining the semester learning plan; 3) creating a learning contract between the lecturer and students; and 4) posting the learning contract online.

2.2 usage of open source applications in learning

The usage of software programs like OPEN Source Impress, Writer, and Calc, which are not only free but also simple to get on the Internet for free and without charge, is one of the benefits of technology when it comes to training our instructors. Like using Impress to create a straightforward presentation, using Open Source Software in Education Technology is fantastic.

Information sharing is encouraged through open source software, which is seen as a strong and advantageous idea. An unbiased evaluation of popular open source software (OSS) products, most of which are created by unpaid volunteers, frequently reveals that they are of a higher caliber than the software produced by some of the most well-known companies, which unquestionably employ highly intelligent individuals. Every member of the community contributes to the so-called "collective open source knowledge" by coming up with fresh concepts, creating innovative features, offering test data, and recording deployments. (Joshua,2012).

As a result, community members' ongoing OSS advancements produce tools that are more dependable and adaptable and have greater quality than their commercial counterparts. As a result, several well-known open source software applications go through continuous development and have a higher reliability rate than their commercial counterparts (Lakhan and K. Jhunjhunwala,2008). Therefore, keeping track of such modifications is a fantastic learning tool that allows a student to regularly analyze and study the changing code in order to comprehend its logic and design as well as the developer's

methods. In addition to learning how to utilize the existing software, the user of the code might potentially alter the design by adding new features to enhance the tool. (Dorodchi, & Dehbozorgi,2016). Users have the ability to modify the solution for their needs after understanding open source code. Martin (2013) also noted that as many OSS projects employ hundreds of developers globally, they are better able to keep up with emerging technological developments. With so many people contributing to these initiatives, productivity is increased while the requirement for technical know-how and training to work with them is reduced. Thus, open source software could aid students in learning how to modify existing scripts in accordance with specifications. As a result, open source motivates pupils to create as well as organize and carry out ongoing improvements (Burdge,2016).

Many educators have thought about using open source (OS) and free and open source software (FOSS) in education in general and computer science education in particular. For instance, Dionisio (2007) address the benefits of and trends in the usage of open source in undergraduate computer science teaching. Software engineering and development is one of these disciplines. The majority of undergraduate students always create their programs (and algorithms) from scratch while working alone, which is completely at odds with the manner that businesses typically build software. In other words, students typically do not work on another people's code.

As a result, they could encounter additional difficulties when they first enter the workforce and are assigned to a group of developers who are working with legacy codes. On the other hand, in terms of the quantity of resources used and the number of lines in the code, industrial initiatives have substantially greater code sizes than academic ones. For recent computer science grads, this mismatch could lead to more issues at work. We firmly believe that incorporating open source into software engineering courses infuses powerful features from the realm of professional software engineering to address a simple solution to the aforementioned problems. (Dorodchi, & Dehbozorgi,2016).

Changes in technology have had a rapid impact on the education sector, and technology is now pervasive in our daily lives. It has an impact on social interaction, online gaming, and learning most significantly. There are numerous software

programs that can be utilized to assist the curriculum, including open source software, which comes in many different formats. For pupils, it might make exercises simpler. Any source, including the internet, can be credited. Teachers and students are far more aware of adopting free software today than they were a few years ago.

According to David Goodrum (2018), director of academic technology and information services at Oregon State University's campus technology, personalized instruction, new collaboration models, and a variety of innovative learning strategies are just a few of the ways that digital education is generating new learning opportunities as students engage in online and digital environments. Open source software is not intended to take the role of educators. Instead, the goal is to foster a broad atmosphere for learning and open doors to fresh encounters that inspire ideas. It transforms the learning atmosphere in the classrooms to one that is more collaborative. Teachers come up with inventive ways to educate their students new ideas and concepts in various contexts. The use of these tools by a teacher is very beneficial. To pique their students' interest and attention, teachers used a variety of reasons, including multi-media presentations.

According to Dorodchi, & Dehbozorgi (2016), open source software is simple to use and is available online for free download. It's fantastic to use open source software in education, such as Impress, which may be used to create straightforward presentations. Technology is more than just laptops, computers, telephones, and tablets, as we like to think of them. The use of technology has a significant impact on both students and teachers. Without technology, we would find it difficult to quickly adapt to our society's rapid change. It is allowing us to become more independent. With the ongoing developments, students can progress in the many educational chances. Students may readily obtain the material, which is quite useful for them as it is only a click away and contains all the information required. By using open source teaching methods, students can gain specific literacy skills. Due to advancements, the old educational system is already losing ground. Learning, however, is made simple and extremely advantageous for both teachers and students in our modern educational system.

2.3 collaborative learning

Rapid technological advancements have simplified distance learning (McBrien et al., 2009). The ability to utilize a computer connected to a network, which provides the option to learn from anywhere, anytime, in any rhythm, with any means, is shared by the majority of the words (online learning, open learning, web-based learning, computer-mediated learning, blended learning, for example) (Cojocariu et al., 2014). Flipped classrooms and blended learning are learning environments that combine in-person lectures with technology to maximize students' learning potential. Students can learn at anytime, anyplace, and gain new abilities that will help them learn for the rest of their lives. The government is also aware of the rising significance of online education in today's fast-paced society. A technology that can help the teaching-learning process be more student-centered, inventive, and flexible is online learning. "Learning experiences in synchronous or asynchronous environments using various devices (e.g., mobile phones, laptops, etc.) with internet connection" is how online learning is defined. Students can learn and interact with teachers and other students anywhere (independently) in these settings (Singh & Thurman, 2019). In contrast to asynchronous learning environments, which are poorly structured, synchronous learning environments have students participate in live lectures, real-time interactions between teachers and students, and the potential for quick feedback.

Many institutions all around the world have completely digitalized their operations due to the pressing demand of the moment. In the middle of this confusion, online education is emerging as the victor. Therefore, at this point, improving the quality of online teaching and learning is essential. The number of Chinese institutions offering courses online has skyrocketed since the Covid-19 epidemic. Normal classrooms were transformed overnight into online classrooms, which means that educators had to change their entire pedagogical strategy to address the changing market realities. In these trying times, the question is not so much about whether or whether online teaching and learning techniques can deliver high-quality education as it is about how academic institutions will be able to implement online learning so widely (Carey, 2020). Learning materials are available through various learning systems and forums rather than in the form of live lectures or seminars in such a learning environment. (Basilaia

et al., 2020). In such a setting, instant feedback and prompt action are not possible (Littlefield, 2018). There are numerous opportunities for social engagement during synchronous learning (McBrien et al., 2009).

E-learning has started to gain popularity in India during the past few years. Massive Open Online Courses are offered through a variety of sites at reasonable prices for students. Many Indian institutions were still wary of online teaching and learning. The difficulties brought on by the Corona Virus outbreak, however, exposed everyone to a brand-new realm of online education and remote teaching. Although certain platforms, like Google Hangouts, Skype, Adobe Connect, Microsoft Teams, and a few others, were used by instructors to partake in remote teaching, ZOOM came out on top. Additionally, in order to run teaching-learning programs smoothly, students were given the correct directions for attending classes as well as a list of online etiquette (Saxena, 2020).

In light of the spread of this deadly virus, it is necessary to create online platforms where

- (a) video conferencing with at least 40–50 students are feasible.
- (b) discussions with students can be held to maintain an organic learning environment.
- (c) internet connections are strong.
- (d) lectures are accessible on mobile devices as well as laptops.
- e) the ability to view previously recorded courses.
- f) the ability to get immediate feedback from students.

The use of technology has expanded the scope of the educational system, and as new e-learning tools are developed daily, it becomes more difficult to design an efficient system. Numerous studies have been done in this area, and the findings have indicated a fairly dramatic change in just the last two decades. Distinct learning and teaching environments have different requirements for how faculty knowledge is transferred to students. Every teacher and faculty member nowadays is digitally literate and capable of using technology in the classroom for instruction in addition to many forms of

assessments, especially in the higher education sector. However, the difficulties arise when it comes to some particular types of learning environments, such collaborative learning environments, which involve multiple students working in groups. A variety of technologies are available to help such a teaching and learning environment. This study report emphasizes the necessity for a new framework because outdated systems require updating as technology develops and curricula change. In some ways, teaching is a creative endeavor where information is transferred to students through the arts. It is a teacher's responsibility to spread knowledge in the classroom using the most effective techniques. The teacher's job is to determine the needs of the students and any obstacles to learning they may be facing. Simulators are used in computer hardware instruction to help students comprehend it better by showing them how the hardware actually works from the inside out. Blended learning is utilized to improve the educational experience for students, where both theoretical and practical concepts must be incorporated (Hasan, Ali, & Hayat, 2015). help enhance the discovery learning process by allowing students to quickly perceive and understand examples GeoGebra is utilized for mathematical and statistical analysis, and other multimedia tools are integrated to improve students' learning experiences (GebreYohannes, Bhatti, & Hasan, 2016).

Few tried activity-based learning, where the teacher watched the effects of teaching and learning, to improve student engagement and learning experiences (Hayat, Hasan, Ali, & Kaleem, 2017). The ideal learning environment is one that encourages the finest teaching methods and maximizes student engagement.

To improve students' knowledge of foundational ideas, interactive technologies are used. Teachers can quickly adapt open source tools and improve the teaching and learning process by using games or technology-assisted learning, according to Naidu, Balushi, and Bhatia (2017). (Naidu, Singh, Harrasi, & Balushi, 2017). The literature review makes clear that technology and tools are crucial for knowledge transfer. Regardless of the learning method chosen, it is crucial that peers work together to create a collaborative learning environment in order to promote knowledge dissemination. This will result in a better learning experience. According to the connected study, there is a need to integrate the right tools with the process for choosing learning styles.

Long-term benefit is possible due to the inclusion of all levels of learning.

E-learning is supported by several arguments. Some of the defenses of online pedagogy include accessibility, cost, flexibility, learning pedagogy, lifelong learning, and policy. Online learning is believed to be easily accessible and capable of reaching even rural and isolated regions. It is seen as a somewhat more affordable kind of education due to the lower costs of travel, lodging, and institution-based education as a whole. Another intriguing feature of online learning is flexibility; students can arrange or manage their time to finish online courses.

2.4 Benefits of open source applications in education

Numerous and diverse advantages have driven the usage and development of open source software. This benefit has a variety of just plain practical concerns to philosophical and ethical considerations. For the purposes of this paper, we will focus on the following list of practical concerns, as outlined by Barahona (2000):

- a) **Quality**-A software package made by a small group of developers or one made by thousands of people is more likely to be superior. As many developers and users are striving to increase the security of open source software as there are developing new features and improvements for those products. Open source software typically comes the closest to delivering what consumers desire since those users can influence its development. Users and developers create what they want and do it effectively, thus it is not the vendor's responsibility to provide users with what it believes they want. Technical superiority is often the main reason businesses pick open source software, according to at least one recent survey. (Adamu & Kuba.2020).
- b) **Reliability**-The absence of flaws that could result in improper functioning, data loss, unexpected failures, or failure to satisfy relevant published standards—commonly referred to as "bugs"—makes open source software dependable. This is not to imply that issues with OSA are never encountered, but each issue is typically resolved quickly, a process that is unquestionably aided by the availability of

the source code. As a result, proponents of Open Source assert that applications have exceptionally quick time-to-fix qualities. A defect report is often required for closed-source applications, after which there is a delay while the vendor decides whether or not to release an updated version. Compared to an open source setup, users of closed-source applications are far more at the mercy of the vendor's internal procedures. (Adamu & Kuba.2020).

- c) **Stability**-according to Adamu and Kuba (2020), vendors of proprietary applications might use a variety of strategies to induce more or less agreeable upgrades from their clients. Common strategies include switching to ostensibly newer and better file formats (which need the newer and better Application to read them) or discontinuing support and bug patches for earlier versions after a brief period. The issue for such Application users is that they have little to no control over that process and are left in the dark if they decide to stick with previous versions. While the worst consequences of vendor push can be lessened with OSA, this has ramifications for the business in terms of costs and management. If a company has access to the source code, it may decide to support an older version as appropriate, providing people more alternatives and choices. (Adamu & Kuba.2020).
- d) **Audit ability**-The ability to audit an Open Source Application (any Application whose source code is published) is a little-known advantage. When the vendor makes claims about traits like security, lack of backdoors, adherence to standards, and adaptability in the face of future developments, closed-source applications oblige their customers to believe the vendor. Those claims remain nothing more than claims in the absence of the source code. Users of the Application can feel confident that there is a foundation for such assertions because writers made the source code available. Inspection by a third party is impossible without access to the source. (Adamu & Kuba.2020).
- e) **Cost**-The majority of open source software is offered without any charges or royalties. Since there is no expense associated with the number of copies

used, unlike when a proprietary application is used, administrative overhead costs are dramatically reduced. Additionally, since there are no upgrading fees, there are cheaper administrative costs. Virtually no virus vulnerability means no need for virus scanning, no data loss, and no downtime. (Adamu & Kuba.2020).

3.0 RESEARCH METHODOLOGY

The design of the study is the strategy for carrying out the study. It is concerned with what kinds of data or information will be collected and how that data will be collected (Berg, 1995). Jen (2007) describes survey design studies as ones that record the nature, range, dimensions, and directions of actions, behaviors, attitudes, and other things relating to people or objects.

In order to learn more about the choices, attitudes, preferences, and perceptions of the people who the researcher is interested in, the researchers employed a descriptive survey study design, which involved input from a sample population. In the investigation, a mixed method approach was used. 180 staff members and students were purposefully chosen at random for the study at Zetech University, and a sample of 118 was taken. In the quantitative approach, the descriptive statistics were employed to display the distribution of scores using a few indices.

4.0 FINDINGS

4.1 Demographic Information

Table 1: Gender

		What is your gender			
		Frequenc y	Percent	Valid Percent	Cumulative Percent
Vali d	Femal e	1	.8	.8	.8
	Male	28	23.7	23.7	24.6
	Total	89	75.4	75.4	100.0
		118	100.0	100.0	

According to table 1 above 75.4% of the respondents were male while 23.7% were females.

Table 2: Level of Education

Which is the highest Level of Education you have attained?

	Frequency	Percent	Valid Percent	Cumulative Percent
	2	1.7	1.7	1.7
Certificate	20	16.9	16.9	18.6
Degree	26	22.0	22.0	40.7
Diploma	66	55.9	55.9	96.6
Master's	4	3.4	3.4	100.0
Total	118	100.0	100.0	

According to table 2 above 55.9% of the respondents had diplomas, 22% had degrees, 16.9% certificate while 3.4% had master's degree as their highest level of education.

Duration in the university

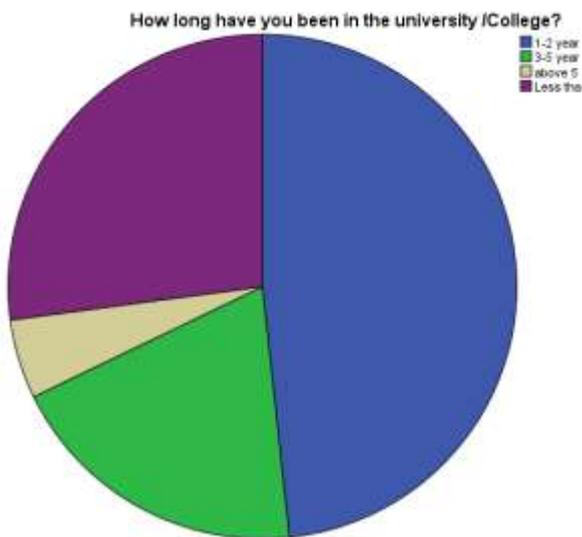


Figure 1: Duration of respondents in the university
 According to figure 1 above majority of the respondents had been in the university for one or two years.

Table 3: Occupation in the university

What is your occupation within the university?

	Frequency	Percent	Valid Percent	Cumulative Percent
Staff	10	8.5	8.5	8.5
Student	108	91.5	91.5	100.0
Total	118	100.0	100.0	

According to table 3 above 91.5% of the respondents were students while 8.5% were staff.

4.2 Overview of open source software's usage and applications

Table 3: Type of software used by correspondents

Which type of software have you used?

	Frequency	Percent	Valid Percent	Cumulative Percent
All	1	.8	.8	.8
Open source	80	67.8	67.8	68.6
pirated	3	2.5	2.5	71.1
Proprietary	4	3.4	3.4	74.5
Total	118	100.0	100.0	

The majority of respondents, or 67.8%, utilized open source software, while 25.4% used all of it, 2.5% used pirated software, and 3.4% used proprietary software, according to table 3 above.

Table 4: Familiarity of open source applications

Are you familiar with open-source applications?

	Frequency	Percent	Valid Percent	Cumulative Percent
No	11	9.3	9.3	9.3
Yes	107	90.7	90.7	100.0
Total	118	100.0	100.0	

Table 4 above shows that 90.7% of respondents were familiar with open source software, while 9.3% were not.

Type of operating system

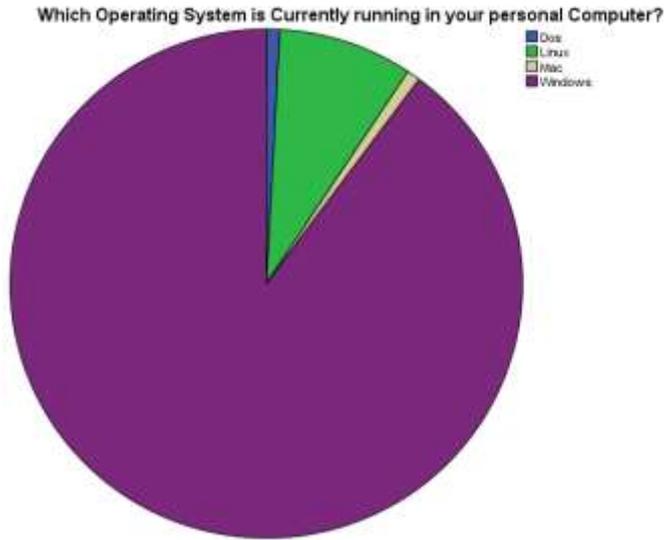


Figure 2: Type of operating system being used by respondents.

According to figure 2 above majority of the respondents were using windows-based operating system while the least used mac.

Table 5: Open source applications usage in teaching and learning computing courses

Do you believe that the usage of open-source applications in teaching and learning computing courses in the institution of higher learning is essential?

	Frequency	Percent	Valid Percent	Cumulative Percent
No	2	1.7	1.7	1.7
Valid Yes	116	98.3	98.3	100.0
Total	118	100.0	100.0	

Table 5 shows that 98.3% of respondents believed it was crucial to use open source software when instructing computer science courses, whereas 1.7% disagreed with the thesis.

Table 6: Universities using open source applications

Are you familiar with any university or organization that uses Open Source Software as their official use?

	Frequency	Percent	Valid Percent	Cumulative Percent
No	38	32.2	32.2	33.1
Valid Yes	79	66.9	66.9	100.0
Total	118	100.0	100.0	

Table 6 above shows that 66.9% of respondents were aware that colleges used open source software for official purposes, whereas 32.2% were not.

Table 7: Usage of open source applications in Curriculums

Are you familiar with any university that uses Open Source Software as a part of their curriculum?

	Frequency	Percent	Valid Percent	Cumulative Percent
No	33	28.0	28.0	28.8
Valid Yes	84	71.2	71.2	100.0
Total	118	100.0	100.0	

Table 7 above shows that 71.2% of respondents were aware that universities use open source software in their curricula, whereas 28% were not.

Table 8: Open source applications interaction with users

Which type of open-source application have you interacted with in learning?

	Frequency	Percent	Valid Percent	Cumulative Percent
BigBlueButton	39	33.1	33.1	34.7
Valid GitHub	37	31.4	31.4	66.1
IDEs	6	5.1	5.1	71.2
Linux	1	.8	.8	72.0
Moodle	17	14.4	14.4	86.4

Open Admin	1	.8	.8	87.3
Open eLearning	15	12.7	12.7	100.0
Total	118	100.0	100.0	

According to table 8 above 33.1% of the respondents had interacted with the BigBlueButton (BBB),31.4% Github,14.4% Moodle, 12.7% open learning, 5.1% IDE's, while 0.8% had interacted with Linux and open admin.

4.3 Overview of open source software's usage and applications

Table 9: Open source applications usage

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Open Source Software is part of our teaching and learning process	2.5%	3.4%	8.5%	37.3%	48.3%
The study of open-source software should be compulsory for all computing courses in the university	3.4%	3.4%	17.8%	33.1%	42.4%
Universities should replace proprietary software with open source software for saving money on license renewal fees, up gradation charges etc	3.4%	5.1%	12.7%	40.7%	38.1%
I feel that open-source software has transformed the education sector	3.4%	3.4%	11.0%	33.1%	49.2%
I feel that teacher comes up in creative ways to teach their students using open FOSS	4.2%	5.1%	14.4%	38.1%	38.1%

Use of Open Source Software would provide a practical learning experience to the learners taking computing courses	3.4%	3.4%	11.0%	36.4%	45.8%
Course Outlines of all Computing Courses should have list of most relevant open source software useful in each course	3.4%	2.5%	10.2%	39.8%	44.1%
Institutions of Higher learning should have policy guidelines on use of Open Source Applications	3.4%	2.5%	12.7%	44.1%	37.3%
The Students and staff are fully aware of the available Open Source applications for use in teaching and learning	5.1%	6.8%	20.3%	37.3%	30.5%

Table 9 above indicates that 48.3% strongly agreed that using open source software is a component of our teaching and learning process, followed by 37.3% strongly agreeing, 8.5% neutrally agreeing, 3.4% disagreeing, and 2.5% strongly disagreeing. All university computing courses should require the study of open-source software, according to 42.4% of respondents, while 33.1% agreed, 17.8% were neutral, and 3.4% disagreed. Universities should switch to open source software instead of proprietary software to save money on license renewal and upgrade fees, a position that was strongly supported by 38.1%, agreed by 40.7%, was neutral by 12.7%, and disagreed by 5.1% and 3.4%. Open-source software has significantly changed the educational landscape, according to 49.2% of respondents, 33.1%, 11%, and 3.4% of those who agreed strongly. 38.1% of respondents agreed, 38.1% strongly agreed, and 14.4% disagreed that teachers come up with innovative ways to teach their students using free and open source software. 5.1% and 4.2%, respectively, strongly disagreed. When asked if using open source software would give students enrolled in computing courses a real learning

experience, 45.8% strongly agreed, 36.4% agreed, 11% were neutral, and 3.4% disagreed. 44.1% strongly agreed, 39.8% agreed, 10.2% were indifferent, and 2.5% disagreed that the course descriptions for all computing courses should include a list of the most pertinent open source software beneficial in each course. When asked whether higher education institutions should have policies governing the usage of open source software, 37.3% strongly agreed, 44.1% strongly agreed, 12.7% were neutral, 2.5% disagreed, and 3.4% strongly disagreed. 30.5% highly agreed, 37.3% agreed, 20.3% were indifferent, 6.8% disagreed, and 5.1% strongly disagreed that the students and faculty are fully aware of the various Open Source apps for use in teaching and learning.

Table 10: Accessibility of Open Source Applications to potential computing educators & learners.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I believe that the FOSS is easily accessible to students and educators	4.2%	2.5%	23.7%	39.8%	29.7%
It is easy to conduct an audit of the FOSS due to the availability of codes.	5.1%	3.4%	16.1%	44.1%	31.4%
FOSS allows previously recorded classes to be retrieved easily	4.2%	0.8%	18.6%	39.0%	37.3%
The university has provided the necessary enabling environment for students and staff to access Open Source Applications	5.1%	2.5%	14.4%	46.6%	31.4%

Info-sessions should be provided by computing departments to sensitize them on use of open source applications in teaching and learning	4.2%	0.8%	8.5%	51.7%	34.7%
The ICT Infrastructure in the University has restricted us from use of Free open source software	4.2%	13.6%	29.7%	25.4%	27.1%
I believe that open-source applications are of high quality.	4.2%	3.4%	15.3%	44.9%	32.2%

Table 10 shows that 29.7% of respondents think that kids and teachers can readily use the FOSS, whereas 39.8% agreed, 23.7% were neutral, 2.5% disagreed, and 4.2% strongly disagreed. Due to the availability of the codes, doing an audit of the FOSS is simple, an idea that was strongly backed by 31.4%, agreed by 44.1%, neutral by 16.1%, disagreed by 3.4%, and severely disagreed by 5.1%. 37.3% highly agreed, 39% agreed, 18.6% were indifferent, 0.8% disagreed, and 4.2% strongly disagreed that FOSS makes it simple to retrieve previously recorded lessons. According to the survey, 31.4% of respondents highly supported the university's provision of the necessary enabling environment for staff and students to access open source software, while 46.6% agreed, 14.4% were indifferent, 2.5% disagreed, and 5.1% strongly opposed. Info-sessions should be offered by computer departments to educate faculty and staff on the use of open source software in teaching and learning, according to 34.7% of respondents who strongly agreed with this. In total, 51.7% agreed, 8.5% were indifferent, 0.8% opposed, and 4.2% strongly disagreed. 27.1% of respondents strongly agreed that the university's ICT infrastructure prevents us from using free open source software. 13.6% disagreed, 4.2% severely disagreed, 25.4% disagreed, 29.7% were neutral. Open-source software is of

good quality, according to 32.2% highly; 44.9% agree; 15.3% are neutral; 3.4% disagree; and 4.2% strongly disagree.

5.0 DISCUSSIONS

Open source software is not meant to replace educators in the classroom. Instead, the objective is to promote a diverse learning environment and offer doors to novel encounters that stimulate creative thought. It changes the classroom learning environment to one that is more collaborative. Teachers come up with creative ways to introduce new ideas and concepts to their pupils in a variety of settings. These resources are really helpful for teachers to use. Teachers used a range of techniques, such as multimedia presentations, to grab their students' interest and attention. Universities should switch to open source software instead of proprietary software to save money on license renewal and upgrade fees, a position that was strongly supported by 38.1%, agreed by 40.7%, was neutral by 12.7%, and disagreed by 5.1% and 3.4%. According to 49.2% of respondents, 33.1%, 11%, and 3.4% of those who strongly agreed, open-source software has drastically altered the educational landscape. 38.1% of those surveyed agreed, 38.1% strongly agreed, and 14.4% disagreed that educators should come up with creative ways to teach pupils using free and open source software.

On external platforms like Zoom, Google Meet, and others, synchronous learning is employed more frequently than on internal features. The culprit is Bigblue Button's infrequent use. Capacity is a crucial factor to consider while trying to improve the system's ability to run higher education. The Moodle platform's technical backbone needs to be improved. According to Naz and Khan (2018), a learning management system must offer trustworthy administration, tracking, reporting, and automation. When asked if using open source software would give students enrolled in computing courses a real learning experience, 45.8% strongly agreed, 36.4% agreed, 11% were neutral, and 3.4% disagreed. 44.1% strongly agreed, 39.8% agreed, 10.2% were indifferent, and 2.5% disagreed that the course descriptions for all computing courses should include a list of the most pertinent open source software beneficial in each course. The extensive use of external usage does not appear to have affected any of the processes for administration, tracking, reporting, or automation (Makruf et al., 2022). The ideal educational process depends on a variety of elements, including student and teacher digital literacy, teaching methods, student

interaction, student-faculty relationships, quick feedback, active learning, collaborative learning, technology application, and many others (Coman et al., 2020). Additionally, an important consideration is the usage of interactive tutorial films in instruction by including YouTube embed codes on Moodle (Nagy, 2018). Utilizing open source software is a part of our teaching and learning process, with 48.3% strongly agreeing to this statement, followed by 37.3% strongly agreeing, 8.5% neutrally agreeing, 3.4% disagreeing, and 2.5% strongly agreeing. According to 42.4% of respondents, all university computing courses should require the study of open-source software, while 33.1% agreed, 17.8% were neutral. Wambui et al. (2022) ascertains that using a variety of open source apps, many institutions of higher education have shifted from the outdated classroom model to online courses, as well as from the outdated offline evaluation method to an online one. Using online assessment tools, they are evaluating themselves. Online evaluation tools are nonetheless subject to these limitations. While compared to the norm, several measurement mistakes are reported while using online evaluation tools.

6.0 CONCLUSIONS

Universities all throughout the world are now dealing with new learning management requirements and cultures as a result of the Covid-19 pandemic. A new hope emerges in the form of digital platforms like web-based learning management. In order to ensure deployment and learning quality assurance, IAIN Surakarta created the Moodle-based learning (SiKulon) platform. According to the research's findings, online learning management is less effective, particularly in the areas of learning implementation and learning evaluation. However, learning is included in the high- or optimal-use planning. The paradigm for education must change to Education 4.0 in order to give innovatively productive education. To do this, both instructors and faculty members can benefit from a range of cutting-edge tools and technologies.

This study identified flaws in crucial learning management components. system, namely the application and assessment of learning. Many instructors continue to use systems besides Moodle for the application of learning, such as synchronous learning (virtual face-to-face learning), use Zoom, Google Meet, or another platform. For asynchronous learning, use Google Classroom, WhatsApp, or another platform. Three

primary criteria, including system quality, supporting infrastructure, and user capability, can influence this choice. These technologies can be utilized to record students' participation and engagement in the module both on and off the campus with the use of IoT and ontology (Mahmood et al., 2019; Sarker et al., 2019). Virtual learning environments can be utilized in conjunction with other blended learning environments to cater to a range of learner types (Hasan et al., 2019). Accordingly, it's important to maximize the utilization of the e-learning apps available by providing them with a variety of suitable support capabilities. Similar to the evaluation, the Moodle-based learning application's menu usage needs to be improved for both the system and the users (students and lecturers), especially when it comes to collecting students' work. By maximizing the functionality of the current systems, it is also necessary to increase the use of the evaluation or assessment features. Practitioners must be aware of the potential negative effects of using open source software while developing a product in order to be ready for them, anticipate them, and take the required steps to overcome them. The institutions ought to be linked to website which features a list of open source programs associated with many categories, including security, cloud computing, small enterprises, big data, games, etc. Aspiring computer science teachers' knowledge of open source programs will be improved as a result. As a part in its internal evaluation, an institution may undertake a comprehensive survey. Positive user views represent user expectations, but institutions must also consider performance expectations, effort expectations, social factors, and facility expectations.

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