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The Role of Cloud Computing Technology in Supporting Educational Accessibility and Scalability

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ABSTRACT

Education is very important for human life. Many of them are vying for the best education in the world to guarantee a better future. The thing that is very concerned about in Education is learning and also the right method of teaching, because that way it can give birth to a competitive and quality generation. One of them is the role of cloud computing technology, which is a combination of the use of computer technology and internet-based development. A way or method that makes it easy for users to access information without knowing what is in it, being an expert with it or having control over it. Cloud computing is an important technology that has helped many institutions and schools use distance learning, and can support education's accessibility and scalability. The purpose of this study is to determine the role of cloud computing technology in increasing the accessibility and scalability of more advanced education and being able to create a generation that is highly competitive and virtuous. The method used in this study uses a quantitative method by distributing questionnaires to respondents as many as 15 statements about the use of cloud computing technology in education. The results of this study proved to be a very effective role for cloud computing technology in improving education, because this technology can increase students' interest in learning and make them enthusiastic in learning, so as to create an interactive learning atmosphere. The implication of this latest technology is to make learning more interesting and easily accessible anytime and anywhere by students.

Keywords: *Accessibility, Computing, Scalability*

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INTRODUCTION

Technological advances facilitate all human activities in various fields of life, especially in the field of education. By utilizing digital-based technology, it can make it easier for teachers to provide interesting lesson material and encourage students to ask questions about things they don't understand, so that learning becomes interactive.(Utami et al., 2023). Students can also do school assignments easily, because various learning resources are available on various online-based educational applications and platforms. Just using an internet network and typing your finger, you can get the information you want. It also makes it easier to communicate between friends in each country(Liam et al., 2023). One technology that is intensively used in the education sector is the use of cloud computing. This technology is a combination of the use of computer technology and internet-based development(Manalu et al., 2021). A way or method that makes it easier for users to access information without knowing what is in it, being an expert with it, or having control over it. A simple cloud is the delivery of various computing services(Mohammed Sadeeq et al., 2021), including servers, software, data storage, databases, networks, and analytics via the internet. Cloud computing makes it easier for users to run programs without having to install applications first and makes it easier for users to access data and information via the internet(Dang et al., 2019). With this technology, it can be easier to access data anywhere at any time, just using the internet.

Cloud computing in the world of education has benefits, including being able to hold online classes. Online lessons conducted via applications will not work if there is no cloud-based software(Khayer et al., 2020). Cloud computing technology can even be called a savior when the pandemic era strikes. Offline classes that have been eliminated can be replaced with online classes thanks to this technology. Next, you can use modern learning methods(Butt et al., 2020). Several types of modern learning methods such as hybrid learning, blended learning, flipped classroom can be done thanks to cloud computing. Additionally educators can now share notes and lesson plans quickly and efficiently(Dang et al., 2019). It also allows students to access various resources, such as grades, discussion formulas, and even class lists. Then you can also save costs, implementing cloud computing can save costs incurred by students and schools. Students don't have to buy printed books, but can access lessons via their devices, download digital books or explanatory videos related to the material being studied. Meanwhile for schools, they can save more time, energy and not spend money on physical data and save costs related to IT operations and maintenance(Gao et al., 2020). Furthermore, it reduces the need for hardware, so it can be used by many people without problems. The number of students at each school is large, can be hundreds to thousands. What's amazing is that cloud computing can be used by many people without causing many obstacles. And data security is guaranteed if you use cloud computing, storing data on an internal computer carries the risk of being hacked(Tong et al., 2020). Data may be lost if you only store it on the internal computer. It's different in cloud computing, there is little risk of data being lost because data security there is good.

Cloud computing ideally has the following five characteristics in maximizing services, especially in supporting learning systems, namely on-demand self-services, a service must be able to be utilized by users through an independent mechanism and be immediately available when needed.(Prime, 2021). Second is broad network access, a cloud computing service must be able to be accessed from anywhere, at any time, with any device, provided it must be connected to the internet network. Third, namely resource pooling, a cloud computing service must be available centrally and can share resources efficiently(Muazzinah, 2022). Because cloud computing is shared by various customers, service providers must be able to share the load efficiently, so that the learning system can be utilized optimally(Rani et al., 2021). Fourth, namely rapid elasticity, a cloud computing service must be able to increase or decrease capacity as needed. Lastly is measured service, a cloud computing service must be provided in a measurable manner. Cloud computing services are pay-as-you-go when utilizing this technology(Hossein Motlagh et al., 2020). With these characteristics, it can make it easier to use cloud computing in education, namely to increase the accessibility and scalability of online learning by teachers.(Bernacki et al., 2020). Students can access learning easily and can receive it well and search for various knowledge easily on various educational platforms provided by this technology.

An important factor that determines the success of implementing cloud computing is security, as servers belonging to service providers and educational institutions access it via the internet, so everyone can also access the application. Hackers and intruders will be able to penetrate global application security gaps(Karintseva et al., 2020). Second, namely performance, cloud computing means that resources are located far from the user when compared to traditional centralized systems. This can affect performance, unless it is managed on the internal server itself. Third, namely governance compliance, this technology is not yet fully supported by regulations. For critical matters such as banking, banks are required to have their own servers and place them in the bank's area(Langan et al., 2018). In contrast to agencies providing primary and secondary education with minimal infrastructure, they can use cloud computing services. Fourth is financial, financing for the use of this technology takes into account the use of fixed costs and variable costs(Chou et al., 2018). In the long run, it's cheaper to have your own. These are factors that must be considered to facilitate the use of cloud computing in education. Meanwhile, the challenge of using cloud computing is that you must always be connected to the internet. There are problems during downtime, data security threats, data migration difficulties, poor access management, data loss, data breaches(Mahdavinejad et al., 2018), and others. So you need to pay great attention to using this application.

Several studies that are relevant to this research include, according to(Susanti & Putri, 2020), said in his research entitled the application of cloud computing as an online-based learning medium during the Covid 19 pandemic. The aim is how to build and configure cloud on the server side so that universities can utilize the facilities provided by cloud computing, so that learning objectives can be achieved. Then obey(Sahi, 1970), said in his research entitled the application of academic services in the use of cloud computing technology. Aims to utilize cloud computing technology in

the world of education and provide easy services for all users, especially for the use of educational administration and facilities that can be utilized by all departments in Education to facilitate educational accessibility and scalability. The three obeyed(Wahyudi et al., 2022), said in his research entitled the use of cloud computing to secure data for the world of education. The aim is to find out how to use cloud computing in storing data for all students, and they are taught to use it. The four complied(Erlangga et al., 2022), said in his research entitled development of a mobile cloud computing framework in a mobile learning system to provide video learning. Aims to develop a mobile learning framework for cloud computing technology in education. The difference between this research and previous research is that this research focuses more on utilizing cloud computing for accessibility and scalability in more advanced education.

Review of Literature

1. Cloud Computing

   Cloud Computing or cloud computing is a combination of the use of computer technology and internet-based development. Cloud is another term for the internet, as clouds are often depicted in computer network diagrams. With this technology, there is no need to have a server, electricity, server room, operational staff, storage, software, and other costs related to IT infrastructure(Saskia et al., 2023). You just need to access it in the form of services and pay according to what is needed. Cloud computing is really needed, especially in the education sector, because it can save quite expensive costs and avoid the application of complicated technology. This technology plays a very important role in helping the advancement of education, by following global technological developments, breakthroughs are starting to emerge such as the presence of e-books, they can directly download the book in the form of an e-book on the internet.(Putri et al., 2023). The online academic system is also a cloud computing service. After that you will receive confirmation from the service provider. After that, you will immediately enjoy the information system features provided by the provider(Mustafiyanti et al., 2023). Cloud Computing in the education sector includes Yahoo email, Gmail, Microsoft 365, and others. All you need is an internet connection and students can start sending emails, can get material in distance learning. This technology makes it easier for students to save files for their lessons on personal laptops or external data storage (hardware).(Aceto et al., 2018). They can use cloud storage, which allows students and educators to access their learning materials without worrying about lack of storage. The advantages of this technology in education include helping to ensure the quality of education becomes more effective and efficient, evaluating the teaching and learning process, preparing performance reports, and sharing information and knowledge.

2. Educational Accessibility and Scalability

   Accessibility is a measure of the ease of a location to be reached from other locations via the transportation system. The measure of affordability or accessibility includes the ease of time, cost and effort in moving between places or regions.(Rina & Sugiarto, 2022). Meanwhile, educational accessibility is the convenience provided

to every member of society to take advantage of the opportunity to enter an educational program. Fulfillment of accessibility is a basic right of all people which was built with the aim of creating fair services for all levels of society(Marliana, 2022). Accessibility is also a key in building a naturally inclusive environment. An accessible environment not only facilitates the mobilization and activities of people with disabilities, but also people with special needs(Najwa et al., 2020). Scalability or expandability is the ability of a system, network, or process to handle the additional load given, or its potential to be increased to handle the additional load. A system is said to be scalable if the system can handle additional loads, for example increasing data volume or number of users, without a significant decrease in performance.(Riyadi et al., 2023). In the Learning Management System (LMS) platform that falls into the category suitable for use is when the system has several advantages such as customization, being able to store small things and being flexible. A platform that is considered to have good scalability is one that allows users to use an LMS system that is easy to set up, a system that runs well and, most importantly, continuous development to maintain the performance of the system.(Bennett & Maton, 2010). The scalability of this system removes the limitations that exist in the system, there is no need to worry about the potential for data overflow, because the storage can be added easily and in simple steps.

RESEARCH METHOD

Research methods are scientific procedures, steps or procedures for obtaining data for research purposes that have certain goals and uses. Scientific means research activities that are based on scientific characteristics, namely rational, empirical and systematic as have been explored in the philosophy of science. Rational means that research activities are carried out in a reasonable manner, so that they are within reach of human reasoning(Firmansyah et al., 2021). The research method provides an overview of the research design which includes, among other things: procedures and steps that must be taken, research time, data sources, and with what steps the data is obtained and then processed and analyzed. This research uses quantitative methods, which are methods Quantitative are approaches to empirical studies to collect, analyze and display data in numerical (number) form rather than narrative(Fuadiah, 2022). This research is carried out if you want to obtain accurate results. The aim of quantitative research is to use and develop mathematical models, theories and hypotheses related to a phenomenon. Quantitative methods focus on collecting data that can be measured and assessed objectively. Apart from that, this method is said to be a way to obtain information or solve problems that arise. Statistics where the meter response must use calculated numbers.

This research is very important for building hypotheses that are connected to the natural phenomena to be studied. So this quantitative research has an important goal in carrying out measurements. However, measurement is at the center of research, because research results will help to see the fundamental relationship between empirical observations and quantitative data results.(Risdiana Chandra Dhewy, 2022). Another objective of quantitative research is to help determine the relationship between variables

in a population. This also includes helping in determining the research design. Talking about quantitative research design, it has two forms, namely descriptive studies and experimental studies(Sari et al., 2022). It is said to be descriptive research if the researcher only tests the relationship between variables only once. Meanwhile, what is meant by experimental study research is if the researcher carries out measurements between variables before and after the research. So, these before and after measurements are done to determine cause and effect. It can also be used to find out what phenomena are being researched. Research ethics in conducting this research are norms of politeness in distributing questionnaires to respondents and the public, as well as moral norms that are conscious of being kind and honest in research.

Quantitative research uses a deductive mindset, uses positivistic logic, uses procedural planning, aims to compile knowledge that is nomothetic in nature, data is collected and processed according to plan, involves number calculations or quantification in data variables, analyzed using statistical formulas, data analysis is carried out after the data is successful collected, is called scientific research(Ahmad et al., 2020). Quantitative method research must use steps that are in accordance with the research plan to be carried out. To understand better, here are the steps for research using a quantitative approach. Of course, research begins with a question about an existing phenomenon or problem(Bernacki et al., 2020). The problem formulation is the first point that researchers must pay attention to when conducting research.After finding the problem to be researched, the researcher then prepares a hypothesis and arguments that explain the factors that link the problem with the theory that has been tested. It should be noted that when developing a framework for thinking, it must be based on proven scientific studies, taking into account empirical factors that are relevant to the problem. Hypotheses collected from several facts must be formulated empathetically whether there are scientific studies that are relevant to the hypothesis. After carrying out the research process, the researcher must draw conclusions about the hypotheses that have been tested. After the results are concluded, it will be known whether the hypothesis is accepted or rejected.

RESULTS AND DISCUSSION

When computers were first discovered, they had a very large physical form. Research and development continued until the advent of portable computers called laptops. Then everything became simpler when tablet PCs and smartphones arrived. Not only that, the dependence and massive use of the internet by humans today has also given rise to a technology called cloud computing or what is known as cloud computing. This technology makes it easier for anyone to access various software or complex applications from devices with simple technical specifications. Cloud computing is a technology that combines several storage spaces virtually via an internet network. This technology can be home to various servers, applications, databases, artificial intelligence, and so on. This technology can be developed to support the learning system and help overcome various problems in the implementation of education. The need for efficiency and effectiveness in organizing the learning process is very necessary, especially in terms of improving or maintaining the quality of

learning outcomes. Implementation in the provision of education really needs to be supported by technological capabilities. This cloud education system is divided into three, a centralized cloud educational system, in this system there is connectivity between data centers in educational institutions. The two are distributed cloud educational systems. The third is a hybrid cloud educational system, where provider data centers are interconnected with each other.

Figure 1: Illustration of Cloud Computing Technology

The image above is an illustration of cloud computing technology which is a combination of the use of computer technology and internet-based development. A way or method that makes it easier for users to access information without knowing what is in it, being expert with it and having control over it. It is called cloud computing because information is accessed remotely in the cloud or virtual space. They can access it as long as they have an internet connection. This means users don't need to be in a certain place to get access to their files. Cloud computing can be public or private. Public clouds provide their services publicly on the internet while private clouds only provide services to certain people. Cloud computing provides accessibility, namely making it possible to access data anytime and anywhere, with an internet connection. This makes it easier to access data when needed and can guarantee data security carried out by the service provider. Cloud computing provides scalability in education, namely making it possible to increase data storage capacity without having to buy additional equipment, for example hard disks. As well as the ability of cloud computing systems to adapt to changing computing needs by increasing or decreasing their resources, such as computing power, storage, or network capacity according to demand. Scalability is an important advantage of cloud computing. With accessibility and scalability, all learning activities in the education sector can be facilitated with cloud computing technology.

Several benefits of cloud computing technology. First, cloud computing is scalable, so you can rent it from the smallest option according to your needs. When the need increases, such as increasing application users, it is possible to increase the storage scale to specifications easily. So schools can provide this facility to students to use cloud computing in learning. Second, cheaper costs. Organizations no longer need to spend a lot of money to build server infrastructure, they only need to rent cloud computing services to build virtual servers. The virtual server then just needs to be accessed via existing devices, whether in the form of computers or portable devices. Students make assignments easier because they can access them using smartphones, which most of them already have. Third, good security. Cloud computing service providers generally include advanced security features on their servers. This security feature can protect applications, data and infrastructure from threats. Apart from that, cloud computing also offers advantages in performance, productivity, speed and reliability. One implementation of cloud computing in the world of education is as a learning management system (LMS) server. LMS is a home for various learning materials that will be accessed regularly, anytime, anywhere, even at the same time as students. Next is the creation of educational information systems, libraries and so on. In essence, this technology can increase student involvement in using new technology which becomes a forum for educational institutions to create interactive learning environments.

Figure 2: Opportunity score for using cloud computing technology in education

Aspect	
Opportunities for using computing technology in education	
Agree	Don't agree
80	20

Based on Figure 2 above, it can be concluded that the potential benefits provided by cloud computing technology can increase the accessibility and scalability of education, so that it can provide more optimal learning. Some respondents gave positive answers and reactions to the possibility of using cloud computing technology in the educational sector. The results of the survey conducted as part of the survey also show that there are many benefits to be gained if you make maximum use of this sophisticated technology. One of the advantages of cloud computing technology is that it makes it easier for teachers to provide online learning to students that can be accessed anywhere and at any time, and makes it easier to determine students' interests and talents. Teachers will also find it easy to get their students' personal data without having to write manually.

Figure 3: Challenge Score for Using Cloud Computing Technology in Education

Aspect	
Challenges of using cloud computing technology in education	
Agree	Don't agree

70	30

Based on the results of the research which was accompanied by a questionnaire containing statements from student respondents, it can be concluded that the role of utilizing advanced technology, namely cloud computing, is to easily increase accessibility and scalability in education. Many students find it helpful to study because they utilize the sophistication of cloud computing technology, they learn how to operate this technology for data storage and so on. So great attention needs to be paid to the use of cloud computing in a child's learning. They must be directed to empower the existence of cloud computing to improve all the skills that support them in doing their work. Innovations in limiting the search for a child must also be developed by cloud computing for the common good.

Table

No	Statement	SS	S	RR	STS	T.S
1	In my opinion, the role of cloud computing technology provides great benefits for the world of education to become more advanced and dedicated	50%	50%	-	-	-
2	I feel that with maximum use of cloud computing technology, it can make it easier for students to search for various information without limits	50%	50%	-	-	-
3	In my opinion, cloud computing is distributed computing via a computer network that presents many ideas, technologies and concepts	60%	37%	3%	-	-
4	I feel that cloud computing is becoming very popular because it makes it easier to provide learning materials to students online	80%	20%	-	-	-
5	In my opinion, cloud computing makes learning efficient and effective and saves a lot of time	70%	30%	-	-	-
6	I feel that cloud computing can increase the accessibility and scalability of Indonesian education	50%	50%	-	-	-
7	In my opinion, accessibility is a measure of the ease of a location to be reached from other locations via the transportation system, time and cost	60%	35%	5%	-	-
8	I feel that with accessibility, facilities are provided to everyone with the aim of realizing equality of opportunity in	55%	45%	-	-	-

	aspects of life					
9	In my opinion, decreasing accessibility is influenced by visitor circulation, density and crowd of visitors, capacity and size of space, then furniture	55%	45%	-	-	-
10	I feel that scalability is the ability of a system, network, or process to handle a given or potential increase in load	50%	50%	-	-	-
11	In my opinion, cloud computing in the world of education includes Yahoo Email, Gmail, Microsoft 365, which can make data storage easier.	60%	38%	2%	-	-
12	I feel that the application of cloud computing can be used as a solution for educational institutions to improve the quality of education	50%	50%	-	-	-
13	In my opinion, cloud computing has advantages, including being able to increase storage capacity and helping to save costs	60%	40%	-	-	-
14	I feel that technological advances can make all human activities easier, especially in the field of education, to progress further	50%	50%	-	-	-
15	In my opinion, cloud computing can provide easy access to online learning for teachers and students to interact easily	70%	28%	2%	-	-

The table above is a table of assessment results from the questionnaire given to students. Responses or responses given by students are really needed to provide an assessment of the role of cloud computing technology to increase the accessibility and scalability of education. In this study there were 5 assessment categories, namely strongly agree (SS), agree (S), unsure (RR), disagree (TS), strongly disagree (STS). Based on the first statement, in my opinion, the role of cloud computing technology provides great benefits for the world of education to be more advanced and dedicated. Getting a percentage of 50% in the strongly agree category and similarly in the agree category getting a percentage of 50%. Furthermore, the statement states that I feel that with maximum use of cloud computing technology, it can make it easier for students to search for various information without limits. Getting a percentage of 50% in the strongly agree category and similarly in the agree category getting a percentage of 50% too. In the category that states that in my opinion cloud computing is distributed computing over a computer network that presents many ideas, technologies and

concepts. Getting a percentage of 60% in the strongly agree category, while in the agree category getting a percentage of 37% and in the unsure category getting a percentage of 3%.

Furthermore, I feel that cloud computing is becoming very popular because it makes it easier to provide learning materials to students online. Obtaining a percentage of 80% in the strongly agree category and in the agree category getting a percentage of 20%. In a statement that states that in my opinion cloud computing makes learning more efficient and effective and saves a lot of time. Obtaining a percentage of 70% in the strongly agree category and in the agree category getting a percentage of 30%. Furthermore, I feel that cloud computing can increase the accessibility and scalability of education in Indonesia. Getting a percentage of 50% in the strongly agree category and similarly in the agree category getting a percentage of 50% too. Furthermore, the statement states that in my opinion accessibility is a measure of the ease of a location to be reached from other locations via the transportation system, time and cost. Obtaining a percentage of 60% in the strongly agree category, while in the agree category the percentage was 35% and in the unsure category the percentage was 5%.

In the statement stating that I feel that with accessibility, the facilities are provided for everyone with the aim of realizing equality of opportunity in aspects of life. Getting a percentage of 55% in the strongly agree category and in the agree category getting a percentage of 45%. Furthermore, the statement states that in my opinion the decline in accessibility is influenced by visitor circulation, density and crowd of visitors, capacity and size of space, then the arrangement of furniture. Getting a percentage of 55% in the strongly agree category and in the agree category getting a percentage of 45%. Furthermore, in the statement that I feel that flexibility is the ability of a system, network or process to handle the additional load given or its potential. Getting a percentage of 50% in the strongly agree category and in the agree category getting a percentage of 50% too. Furthermore, in my opinion, cloud computing in the world of education includes Yahoo email, Gmail, Microsoft 365 which can make data storage easier. Obtaining a percentage of 60% in the strongly agree category and in the agree category getting a percentage of 40%.

Furthermore, in the statement that I feel that the application of cloud computing can be used as a solution for educational institutions to improve the quality of education. Getting a percentage of 50% in the strongly agree category and similarly in the agree category getting a percentage of 50% too. In my opinion, cloud computing has advantages, including increasing storage capacity and helping to save costs. Getting a percentage of 60% in the strongly agree category and in the agree category getting a percentage of 40%. Furthermore, in the statement that I feel that technological advances can make all human activities easier, especially in the field of education, to be more advanced. Get a percentage of 50% in the strongly agree category and in the agree category get a percentage of 50% too. Finally, the statement that in my opinion cloud computing can provide easy access to online learning for teachers and students to interact easily. Getting a percentage of 70% in the strongly agree category, while in the agree category getting a percentage of 28% and in the unsure category getting a

percentage of 2%. Based on the questionnaire above, it can be said that respondents strongly support the use of cloud computing for more advanced education.

CONCLUSION

Based on the results and discussion above, it can be concluded that the role of cloud computing technology in the accessibility and scalability of education has been proven to have a big positive impact on the education sector, such as making it easier for students to save files for their lessons on personal laptops or external data storage (hardware). They can use cloud storage, which allows students and educators to access their learning materials without worrying about lack of storage. Furthermore, you can hold online classes, especially when the world is hit by the Covid pandemic which requires all activities to be carried out online. From the questionnaire filled out by respondents, on average they support the maximum use of cloud computing technology to facilitate accessibility and scalability in education. They agree with the statement that there are many positive impacts that cloud computing can have on the education sector in particular. The benefits of this technology have been felt, such as increasing the motivation of learners and teachers, making it easier for students to understand the lessons given by the teacher, creating curiosity about things they don't know, creating a conducive environment. However, despite these benefits, there are still several weaknesses of this technology that need to be paid attention to by the parties involved, in order to maximize the use of the technology. This research method uses a quantitative method by distributing questionnaires to respondents. It contains fifteen questions related to the use of cloud computing technology in education. There are five categories, namely strongly agree, agree, unsure, disagree and strongly disagree. As a result, they support the use of this cutting-edge technology in the teaching and learning process, because the big positive impact can be felt.

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