Evaluating the use of cloud computing technology in the teaching system at the Faculty of Engineering

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Abstrack: The use of cloud computing technology in the field of education is rapidly expanding, especially in supporting online learning in the Faculty of Engineering. This study aims to evaluate the effectiveness and challenges of implementing cloud computing in the learning system, focusing on aspects such as accessibility, collaboration, and technical limitations. The methodology includes surveys of students and lecturers, as well as qualitative analysis of the collected data. The research findings indicate that cloud computing enhances flexibility in learning and facilitates access to lecture materials. However, there are still challenges regarding data privacy and internet connection stability. Recommendations are made to improve network infrastructure and provide further training for users, so that the application of cloud technology can be more optimal in supporting education in the Faculty of Engineering.

Keyword: *Cloud Computing*, *Higher Education, Faculty of Engineering, Online Learning.*

INTRODUCTION

Higher education institutions play a crucial role in the advancement of science and technology for a nation's society. The collaboration among universities, government, industry, researchers, and students has significantly contributed to society and the economic world. Over time, many universities have transformed into research-based institutions, leveraging information technology (IT) infrastructure as the foundation of their academic and research activities. This transformation is supported by technological evolution, which allows traditional educational services to transition into digital or online formats, necessitating reliable, scalable, and secure IT infrastructure (Mircea et al., 2011). In Indonesia, higher education institutions still face challenges in adopting new technologies to improve the quality of educational services. The adaptation process has been slow, partly due to the high costs of IT infrastructure. Financial limitations require universities to maximize their available budget. Cloud Computing emerges as an efficient and affordable solution, enabling higher education institutions to access IT resources

without significant investment in hardware. By utilizing remote servers, the need for extensive internal hardware can be minimized, thus reducing maintenance and operational costs (Erenben, 2009).

Today's students expect flexible digital access, including cloud-based services that facilitate collaborative learning accessible anytime, anywhere. Studies indicate that cloud-based services can reduce costs by up to 40% and increase resource efficiency, providing more flexible and effective learning time (Praveena & Betsy, 2009; Teng & Magoules, 2010). Cloud Computing has now become a primary solution in both the education and industrial sectors, offering flexible, scalable, and on-demand service-based infrastructure through the internet (Foster et al., 2008).

METHOD

To understand the architecture and implementation strategies of Cloud Computing technology at Universitas Muhammadiyah Ar Fachruddin, this research will utilize a literature review methodology. The literature search will focus on cloud computing within the educational context, exploring articles from prominent journals such as IEEE and ScienceDirect published between 2009 and 2012. The search will use keywords like "cloud computing," "cloud in education," "cloud architecture," "cloud strategy," and "cloud in university." This search is expected to yield more than 50 relevant articles. Selection will be based on the relevance of cloud computing technology applications in universities. The screening process will involve reading the abstract and keywords sections to ensure alignment with the research focus. Additionally, this study will incorporate observational methods to gain a deeper understanding of cloud computing implementation at Universitas Muhammadiyah Ar Fachruddin. Through this case study, challenges, benefits, and the effectiveness of the strategies applied in an academic cloud computing context are expected to be identified.

CHARACTERISTICS CLOUD COMPUTING

Cloud Computing is a concept with varied definitions and often misunderstood by many people. In Information Technology (IT) applications and users, cloud computing is generally understood as IT as a Service (ITaaS), which provides computing, data storage, and applications accessible over the internet from a centralized data center. For web application developers, cloud computing serves as a scalable platform for developing

internet-based applications. On the other hand, infrastructure providers define cloud computing as a large-scale distributed data center interconnected through an IP network (Lin et al., 2009). This variation in perspective is evident in the services provided by cloud providers like Google, Microsoft, and Amazon (Cappos et al., 2009).Infrastructure as a Service (IaaS): Layanan ini menyediakan infrastruktur hingga tingkat sistem operasi. Pengguna dapat memilih sistem operasi yang diinginkan dalam bentuk virtual machine dan mengatur sumber daya untuk alokasi perangkat keras seperti ukuran memori, penyimpanan, dan prosesor. Contoh layanan IaaS meliputi Microsoft Azure IaaS, Amazon EC2, Rackspace Cloud, dan OpenStack.

Cloud computing typically includes three primary service models:

● Infrastructure as a Service (IaaS): This model offers infrastructure up to the operating system level. Users can select a desired operating system on a virtual machine and allocate resources like memory, storage, and processors. Examples of IaaS services include Microsoft Azure IaaS, Amazon EC2, Rackspace Cloud, and OpenStack.

● Platform as a Service (PaaS): PaaS provides platform-level services, so users don't have to install operating systems, web servers, or databases. The provider manages the entire operating system and necessary applications, allowing users to upload their applications through a control panel. Examples include Microsoft Azure PaaS, Google App Engine, Amazon Elastic Beanstalk, Cloud Foundry, and Heroku.

● Software as a Service (SaaS): SaaS delivers ready-to-use applications such as office suites, email, and data storage. Examples of SaaS are Office 365, Gmail, Google Docs, Dropbox, and Salesforce.
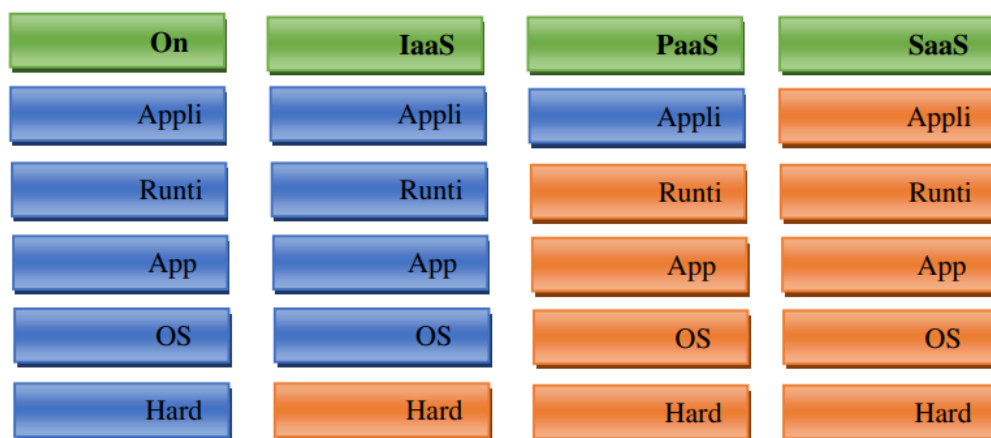

Figure 1. Types of Services in Cloud Computing.

BENEFITS OF CLOUD COMPUTING FOR ENGINEERING FACULTIES

The application of cloud computing within universities offers numerous benefits across the academic environment, positively impacting students, faculty, IT staff, administrative staff, and university management. These benefits can vary across groups, with some experiencing enhanced teaching and learning quality, while others enjoy economic advantages, such as resource savings. Additionally, cloud computing simplifies the maintenance of applications and infrastructure, which is widely recognized as an essential benefit by many users.

For example, cloud computing enables more flexible access to educational resources and provides a more efficient IT infrastructure, which can enhance learning experiences in technical faculties by making them more interactive and engaging. By leveraging cloud-based services, the Faculty of Engineering can reduce operational costs, improve collaboration between faculty and students, and accelerate the process of system updates and maintenance. This is particularly relevant for Universitas Muhammadiyah Ar Fachruddin, where cloud technology can support academic goals and contribute to an overall higher quality of education.In this context, cloud services not only optimize the e ducational process but also offer scalable and secure environments that can adapt to changing academic needs, aligning well with the strategic objectives of universities aiming to stay competitive and technologically advanced in higher education.
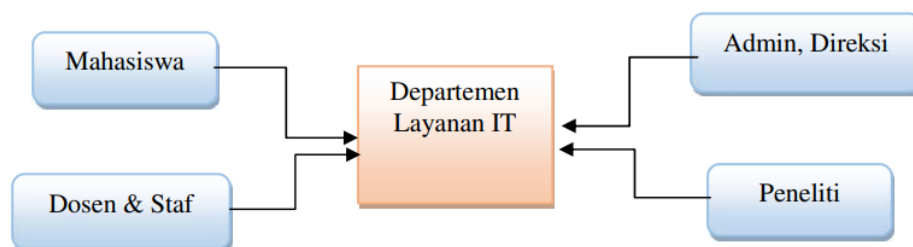

Figure 2 Structure of Cloud Computing Service Users in the Faculty of Engineering.

Cloud computing provides various online services that support universities in enhancing the teaching and learning process more effectively. These applications are typically web-based, allowing easy access from multiple locations and at any time via the internet. According to Alhassan et al. (2015), cloud technology can improve interaction between students and faculty, offering a flexible platform for distance learning.

Furthermore, Hwang et al. (2017) highlight that cloud services in education create opportunities for institutions to integrate a variety of learning resources and facilitate

student collaboration. This aligns well with the objectives of Universitas Muhammadiyah Ar Fachruddin, where implementing cloud computing can enrich learning experiences and optimize the use of existing educational resources. Thus, cloud adoption can play a vital role in creating an adaptable and interactive academic environment.
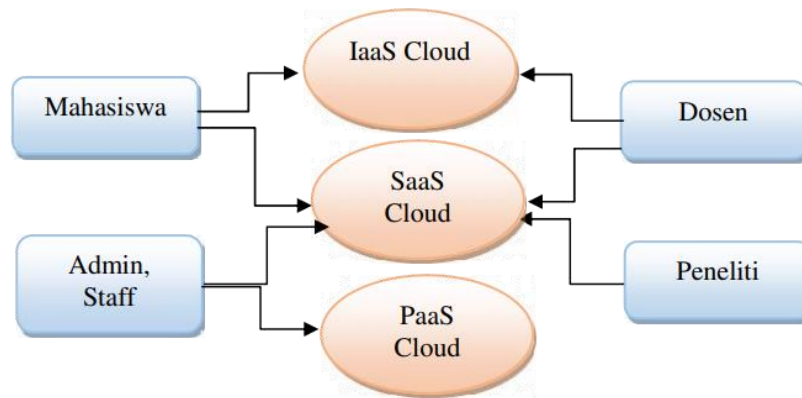

Figure 3 Teknik Cloud Services Accessed by Users in the Faculty of Engineering.

Many cloud computing services, such as Google Docs, Dropbox, and similar platforms, have become integral in university environments. These applications are not only affordable and user-friendly but also highly reliable, making the transition to using them in academic settings much smoother. Since students are generally familiar with these tools, incorporating them into the teaching and learning process is seamless.

Advantages like high availability, quick response times, and scalability make cloud computing highly appealing for educational institutions, especially universities. For example, tools like Google Apps for Education and Microsoft Office 365 provide a range of online productivity tools, such as word processors, spreadsheets, and presentation applications, which can be effectively used in the classroom.

Instructors, for instance, can use Google Sheets to manage and share grades with students online, streamlining access and transparency. Additionally, educators and students can use institution-integrated Google or Microsoft accounts for professional email communications. Video platforms like YouTube are often used for delivering lecture content, while cloud storage services like OneDrive and Dropbox support document management and collaborative projects, enhancing the overall learning experience in a connected and interactive educational environment.

STUDY CASE IN FT UNIMAR

In 2022, the Faculty of Engineering at Universitas Muhammadiyah Ar Fachruddin (UNIMAR) began implementing cloud computing technology, starting with a cloud-based email service using the university's official domain. Previously, UNIMAR managed an internal email server with a custom domain for staff and students, but this approach had several limitations, including:Antarmuka Pengguna yang Kurang Ramah: Antarmuka layanan email yang ada sebelumnya tidak responsif dan sulit diakses dari perangkat mobile.

a. User-Unfriendly Interface: The previous email interface was not mobile-responsive, making it difficult for users to access from mobile devices.

b. Undelivered Emails: Some emails were not sent or were rejected by other servers, which disrupted communication.

c. Low Reliability: Reliance on a local server increased the risk of downtime, especially during power outages.

d. Sync Issues: Users faced challenges syncing their emails with personal devices.

e. Limited Contact Directory: The absence of a user search feature within the domain made it hard for users to locate contacts.

f. Lack of Single Sign-On (SSO): Users needed multiple accounts to access different university services.

Knowing this issue, the lecturers at the Faculty of Engineering UNIMAR took the initiative to look for better email service alternatives and chose Google Workspace for Education. Some reasons for selecting this service include:

a. Vendor Reputation: Google is a well-known and trusted provider of cloud computing services.

b. Cost-Effectiveness: Google offers this service for free to educational institutions.

c. Service Integration: It provides integration with various other Google tools, such as Google Drive and Google Docs.

d. User Familiarity: Staff and students are already accustomed to the Google interface.

After implementing the new email service, the faculty found various benefits, including:

a. Higher Email Access: Students are more active in using email due to a more user-friendly interface and larger storage capacity.

b. Reliability for Staff: Staff find it easier to use the new service, which is integrated with other Google tools.

c. Not Affected by Outages: The service remains accessible even during power outages.

d. Unlimited Storage: Unlimited storage capacity reduces concerns about running out of storage space.

e. Economic Benefits: It reduces the need to manage local servers and maintenance costs.

The Faculty of Engineering at UNIMAR has also begun to utilize other cloud services, such as Google Docs, for document management. With cloud storage services, staff find it easier to access documents from anywhere and do not have to worry about data backup, as all data is stored in the cloud.

The success of implementing cloud-based email services in the Faculty of Engineering at UNIMAR is expected to encourage the university to recommend the widespread use of such services. However, it is important to pay attention to issues related to data confidentiality. Although service providers have good security standards, highly sensitive data should still be stored on local servers while being connected to cloud services, which is known as the Hybrid Cloud approach.

CONCLUSION

Cloud computing is an evolving paradigm that offers a range of computational services that were previously unavailable, particularly benefiting the education sector. This article has discussed the architecture of cloud computing and its applications, focusing on the case study of the Faculty of Engineering at Universitas Muhammadiyah Ar Fachruddin (UNIMAR). The implementation of cloud services, such as email and document storage through Software as a Service (SaaS), has demonstrated significant cost savings in infrastructure related to hardware and maintenance. By utilizing reliable cloud services from trusted vendors like Google and Microsoft, UNIMAR can enhance service reliability without the burden of managing local servers.

In addition to SaaS, UNIMAR should also consider Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) to further support its operations. For instance, migrating servers or information system applications from local servers to the cloud can provide greater efficiency and flexibility. This shift necessitates preparing skilled personnel to manage the migration and ongoing operation of cloud-based systems. It is anticipated that

the benefits from IaaS and PaaS will mirror those gained from their current use of SaaS, including cost savings and improved reliability.

To address sensitive data concerns, UNIMAR could implement a hybrid cloud model. This approach would keep critical information stored on local servers while allowing other applications to run in the cloud. Such a strategy optimizes the advantages of cloud computing while ensuring data security is not compromised.

By embracing these cloud strategies, UNIMAR can leverage advanced technologies to enhance educational processes, improve operational efficiencies, and safeguard sensitive information. As cloud computing continues to develop, institutions that adopt these technologies will likely experience significant transformations in their operational frameworks and educational delivery.

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