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Leveraging Cloud Technologies to Enhance Student Academic Performance

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Abstract

The purpose of this research was to determine how students' use of cloud storage and collaboration, the number of hours spent studying, and academic success are related. K-means clustering was used to evaluate a sample of 408 students, and the results showed that there were three groups of students: those who performed well, those who performed averagely, and those who performed poorly. Higher cloud storage and collaboration use were shown to be positively related to improved academic achievement. Additionally, improved academic achievement was associated with longer study periods. This implies that extending study time and employing cloud technologies will help pupils do better academically. It is advised that students utilize cloud storage and collaboration technologies to enhance their academic performance. They may also collaborate with peers using cloud-based technologies while working on group work. The promotion of cloud storage and cooperation in the classroom may also be greatly aided by teachers. Teachers may help students do better in classrooms by providing them with the information and skills they need to utilize cloud computing tools efficiently. It might be helpful for students to develop their cooperation and collaboration abilities to encourage them to work on group projects or assignments utilizing cloud computing collaboration technologies.

Keywords: Academic performance, Cloud computing, K-means, Personalized education, Students

Declarations

Competing interests:
The author declares no competing interests.

Introduction

There has been a rise in the usage of cloud computing to expand the educational tools and materials available to students and faculty (Alhazzani, 2014). Rather than keeping resources like apps and data storage on a single machine or server, cloud computing makes these services accessible via the internet through a distributed network of distant computers. As a result, users may take use of the available resources whenever they are required without having to set up and manage their underlying computer systems. Increased adaptability and

convenience are two key advantages of cloud computing for educational purposes (Breivold and Crnkovic, 2014; Kalagiakos and Karampelas, 2011). If a student has access to the internet, they can do their schoolwork and research from anywhere in the world using cloud-based tools. Students with flexible job schedules or other commitments may find this option very helpful.

Real-time collaboration and resource sharing are two further positive outcomes of cloud computing in the classroom. The use of cloud-based applications like Google Drive and Microsoft OneDrive facilitates collaborative learning by facilitating the sharing of documents, presentations, and other resources among students working on a common project. This may be particularly helpful for collaborative tasks and group initiatives. The convenience of cloud computing also extends to the dissemination of pedagogical materials including course outlines, PowerPoint presentations, and homework (Askari et al., 2018; Chang and Wills, 2015).

The flexibility to increase or decrease resources as needed is a crucial feature of cloud computing. It's especially useful for schools, where the number of students and faculty members might fluctuate over time since this allows for flexible resource allocation. In addition, this helps institutions save money on information technology since they don't have to buy and maintain their servers and other components.

Additionally, the security and privacy of personal data are much enhanced by cloud computing, both of which are problematic in more conventional IT infrastructures. Cloud service companies often employ a staff of security professionals to guarantee the confidentiality and integrity of user data. This may provide teachers and administrators some much-needed peace of mind, since they may have personal student information that has to be kept secure (Alshuwaier et al., 2012; Campbell, 2016).

Ultimately, cloud computing enables the integration of AI and ML into instructional settings. Using these tools, educators may better understand their students' strengths and weaknesses and tailor their lessons accordingly. Teachers and administrators may utilize this to get insight into their students' learning and use that knowledge to better serve their students.

The use of cloud computing in the classroom is proving to be both practical and economical. The capacity to expand or contract resources in response to changing business demands is a

major benefit. This lets schools scale up or down their IT infrastructure in response to fluctuations in enrollment and staffing levels, reducing the need for permanent infrastructure upgrades. This is especially helpful for educational institutions since they may save money on their IT infrastructure without lowering the quality of the services they provide to their students (Alhazzani, 2014; Hacker, 2011).

The utilization of pay-as-you-go or similar models is another manner in which cloud computing saves money. In the cloud, many service providers now offer a pay-as-you-go approach, so universities and colleges need only pay for the computing power they use. This is useful for schools with a transient student body or those experimenting with new courses or policies. As a result, they may save money and make sure things are being used effectively (Moscow, 2010; Yu *et al.*, 2014). As opposed to being stored on a user's local computer or server, cloud-based resources like software and storage are hosted on a network of distant servers and made accessible through the internet. Because of this, schools can concentrate on giving their students the greatest possible educational experience without worrying about the high cost of purchasing software licenses or new gear.

When compared to more conventional IT infrastructures, cloud computing provides an additional layer of security and data protection. Most cloud service providers employ a staff of security professionals to guarantee the privacy and integrity of customer information (Achar, 2015, 2016, 2018; Krelja Kurelović et al., 2013). Without spending a great deal on security, this may provide teachers and school administrators some much-needed safety when dealing with potentially-vulnerable student information.

Role of cloud computing in academic performance

Cloud computing can significantly improve academic performance by improving accessibility and flexibility of resources (Chang and Wills, 2013; Changchit, 2014). One of the main benefits of cloud computing in education is that it allows for greater flexibility and accessibility. With cloud-based resources, students can access materials and work on projects from anywhere, at any time, as long as they have an internet connection. This is particularly useful for students who are working remotely or have busy schedules, as it allows them to be more flexible and adapt to their own needs and learning style.

Access to cloud-based resources can also help to improve student engagement and motivation. With the ability to access materials and work on projects from anywhere,

students can take a more active role in their own education and engage with the material in a more meaningful way (Alharthi et al., 2015; Kumar et al., 2013). This can help to improve student motivation and engagement, which can lead to improved academic performance.

With cloud-based resources, students can access materials and work on projects from anywhere, at any time, as long as they have an internet connection. This allows students to take control of their own learning and explore new topics and ideas at their own pace. This can help to improve student's critical thinking and problem-solving skills, which can lead to improved academic performance.

Cloud computing also allows for greater collaboration among students and teachers. With the ability to share and access resources from anywhere, students and teachers can collaborate and work together on projects in real-time (Umar et al., 2016; Wu, 2013). This can help to improve communication and teamwork, which can lead to improved academic performance. Cloud computing can also improve academic performance by providing access to resources that would otherwise be unavailable. For example, students in remote or underprivileged areas may not.

Cloud computing can enhance collaboration and communication through the use of video conferencing and communication tools. These tools allow students to participate in virtual meetings and discussions, which can help to improve communication and collaboration among students, regardless of their location (Chen and Almunawar, 2016). This can be especially useful for students who are working remotely or have busy schedules, as it allows them to participate in class discussions and collaborate with their peers.

Cloud computing also allows for better communication and collaboration among teachers. With cloud-based resources, teachers can share and access resources, such as syllabus, lecture slides, and assignments, with students (Aldakheel, 2011). This can help to improve communication and collaboration among teachers, which can lead to improved academic performance for students.

Cloud computing can also significantly improve academic performance by providing a personalized learning experience for students. One of the key benefits of cloud computing in education is the ability to use Artificial Intelligence (AI) and Machine Learning (ML) technologies to personalize learning experiences for students. These technologies allow for

the analysis of student data, such as performance and progress, to create personalized learning plans that are tailored to the specific needs of each student (Okai et al., 2014; Tzenios, 2020a, 2020b). This can help to improve student engagement and motivation, which can lead to improved academic performance.

Adaptive learning software programs use student data, such as performance and progress, to adjust the difficulty of the material and provide personalized feedback (Chao, 2012; Krishnan and John, 2013). This can help to improve student engagement and motivation, as well as to target areas where students need more support. This can lead to improved academic performance, as students are able to focus on the areas where they need the most help. Cloud computing can also personalize learning by providing access to a wide range of resources and tools. This allows students to take control of their own learning and explore new topics and ideas at their own pace, which can help to improve student engagement and motivation, leading to improved academic performance (Al-Badi et al., 2017; Sinha and Shekhar, 2015).

Cloud computing can significantly improve academic performance by enhancing teacher's ability to track student's performance. One of the key benefits of cloud computing in education is the ability to access and analyze student performance data in real-time. Cloud-based tools such as Learning Management Systems (LMS) and student assessment software allow teachers to track student progress, view grades, and provide feedback, which can help teachers to identify areas where students need more support (Iqbal, 2011). This can help to improve instruction and support student success, leading to improved academic performance.

Cloud-based tools allow teachers to analyze student data, such as performance, attendance, and engagement, to identify patterns and trends. This can help teachers to identify areas where students are struggling and provide targeted support and interventions, which can lead to improved academic performance.

Findings, discussion, and challenges

This research applied K-means clustering algorithm and various visual techniques to group students based on the usage of cloud computing. The results of this study, as shown in Figure 1, indicate that there is a positive relationship between the usage of cloud storage and cloud collaboration and academic performance. Specifically, it was found that students who had higher usage of cloud storage and cloud collaboration performed better academically

compared to those who had lower usage. Based on this finding, it is recommended that students make use of cloud storage and collaboration tools to improve their academic performance. Moreover, educators can play a crucial role in promoting the usage of cloud storage and collaboration in their classes. By providing students with the necessary knowledge and skills to use these tools effectively, educators can help students to improve their academic performance. Encouraging students to work on group projects or assignments using cloud collaboration tools can also be beneficial for improving students' teamwork and collaboration skills.

Figure 1. Higher usage of cloud storage and cloud collaboration increase the academic performance

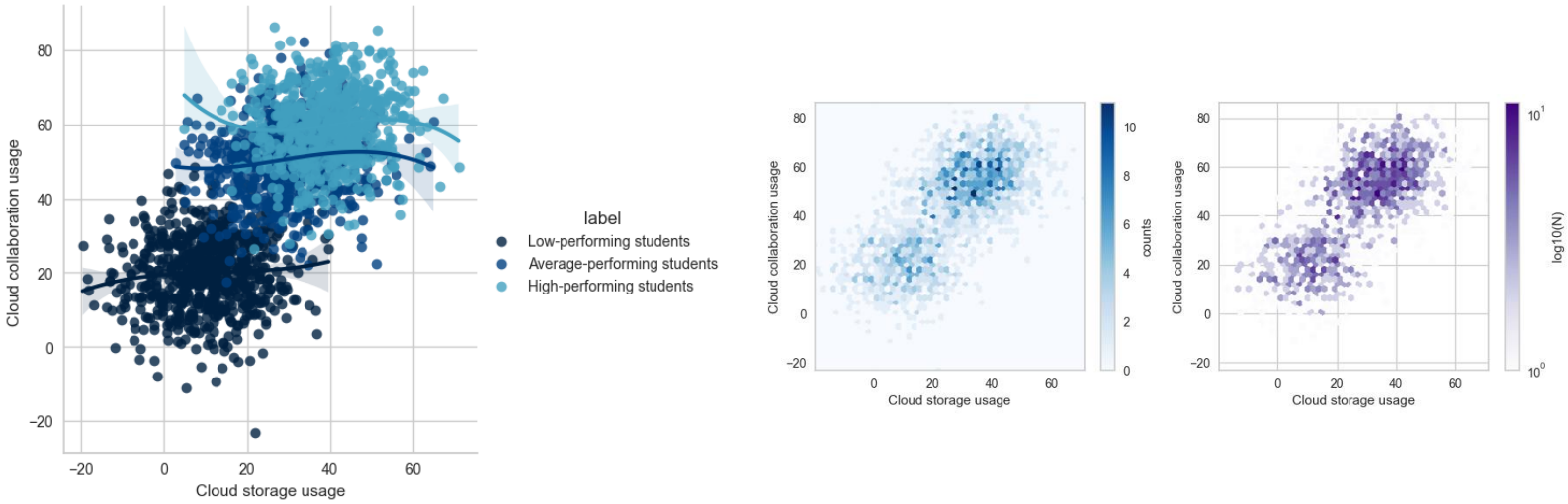
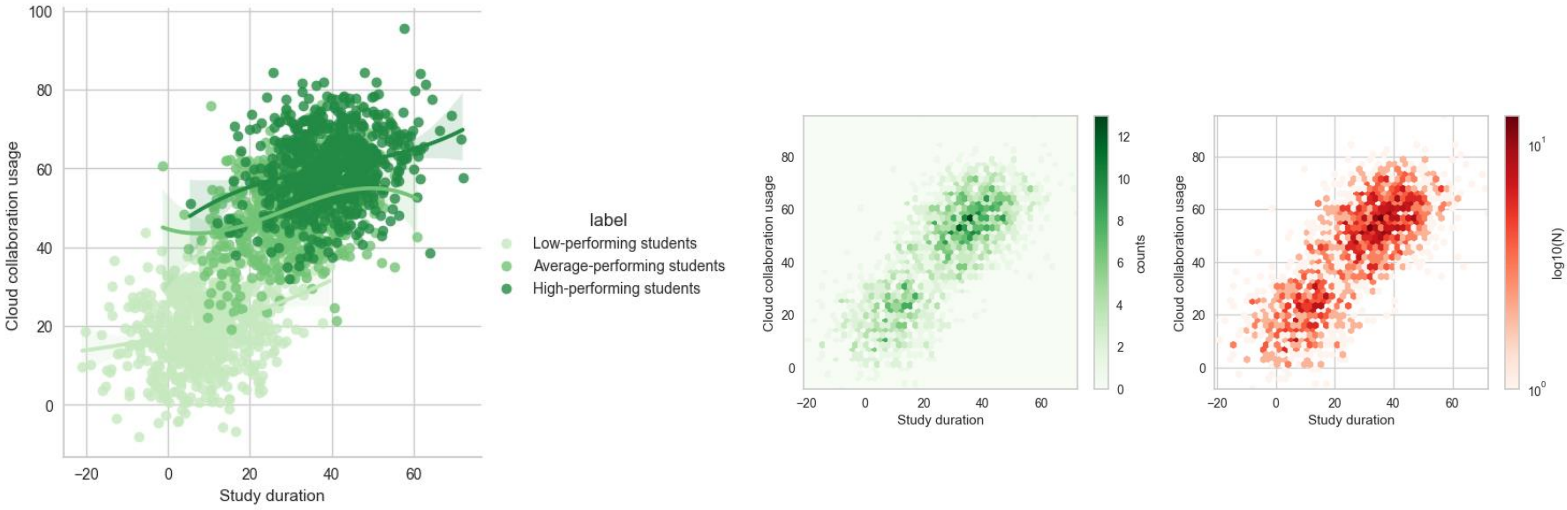


Figure 2 illustrates the results of the study which found that there is a positive correlation between the usage of cloud collaboration, study duration, and academic performance. Specifically, the results show that students who had higher usage of cloud collaboration and longer study duration performed better academically compared to those who had lower usage and shorter study duration. This finding suggests that utilizing cloud-based collaboration tools in conjunction with longer study hours can significantly improve students' academic performance. By utilizing cloud collaboration tools, students can work together on projects and assignments, increasing their teamwork and collaboration skills. Additionally, by having

a longer study duration, students can have more time to focus on their academic materials and have a better understanding of the subject.

Based on these findings, it is recommended that students make use of cloud collaboration tools and increase their study hours to improve their academic performance. Furthermore, educators can promote the usage of cloud collaboration tools in their classes, and encourage students to work on group projects or assignments using these tools. Additionally, educators can give students guidance on how to manage their time and prioritize their studies effectively.

Figure 2. Higher usage of cloud collaboration with longer study duration increase the academic performance

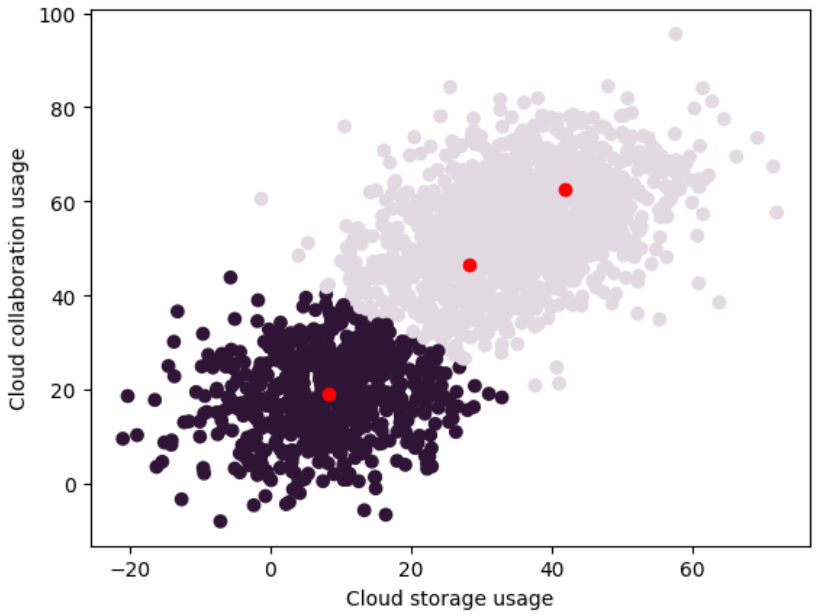


Security and privacy are major concerns when it comes to cloud computing in education. One of the main concerns is the protection of sensitive student information, such as personal identification numbers (PINs), social security numbers, and other personal information. This information is often stored in cloud-based systems and can be vulnerable to hacking, phishing, and other cyberattacks.

Another concern is the control and management of data, as educational institutions may not have full control over the data stored in the cloud. Some cloud providers may have access to the data, which can raise concerns about data privacy and security. Additionally, there is also a risk of data breaches, which can result in the loss or theft of sensitive information, affecting

the institution and its students. These regulations require institutions to protect the personal data of students and faculty, which can be difficult to do when data is stored in the cloud. The security of the cloud infrastructure is also a concern, as cloud providers may not have the same level of security as educational institutions. This can leave data vulnerable to cyberattacks, such as Denial of Service (DoS) attacks, and other forms of cybercrime. Furthermore, if the cloud provider experiences a security breach, it can affect multiple organizations that use their services.

Figure 3. Cluster centres under k-means clustering



To mitigate these security and privacy concerns, educational institutions should implement strict security protocols and use robust encryption methods to protect sensitive data. Additionally, they should also conduct regular security audits and assessments, to ensure that their data is protected. Furthermore, they should also ensure that the cloud provider they are using is compliant with the regulations and has a good track record of security. Limited access to technology in some areas is a significant challenge for cloud computing in education. In many rural or low-income areas, students may not have access to reliable internet connections or the necessary equipment to access cloud-based resources. This can make it difficult for these students to participate in online learning and collaborate with their peers.

Another challenge is the digital divide, which can make it difficult for students from underprivileged backgrounds to access technology and participate in online learning. This is particularly true for students who live in low-income areas or who come from disadvantaged backgrounds. These students may not have access to the necessary technology or internet connection to access cloud-based resources.

This limited access to technology also poses a challenge for educators, as they may not be able to effectively use cloud-based resources to support student learning. Without access to the necessary technology and internet connections, educators may not be able to effectively use cloud-based resources to create engaging and interactive learning experiences for their students. Additionally, limited access to technology in some areas can also make it difficult for educational institutions to implement and manage cloud-based resources. Without access to the necessary technology, institutions may not be able to effectively use cloud-based resources to support student learning and collaboration.

To overcome this challenge, educational institutions should invest in providing students and educators with access to the necessary technology and internet connections. This could include providing laptops or tablets to students who do not have access to their own devices, as well as investing in internet infrastructure in areas where it is needed. Additionally, educational institutions should also work with community organizations and local governments to increase access to technology and internet connections in underprivileged areas.

The need for proper training and support is a significant challenge for cloud computing in education. For educators and students to fully benefit from cloud-based resources, they need to have the proper training and support to understand how to use them effectively. Without proper training, educators may not be able to effectively use cloud-based resources to support student learning and collaboration.

One of the challenges of providing proper training and support is the constant evolution of technology. Cloud-based resources are constantly evolving, and new features and tools are being added all the time. This means that educators need to be continuously updated and trained on how to use new tools and features. Without proper training, educators may not be able to use these resources to their full potential, which can negatively impact student

learning. Another challenge is that different educators may have different levels of technological expertise. Some educators may be more comfortable using technology than others, and this can make it difficult to provide proper training and support. This can also make it difficult for educators to collaborate and share resources, as they may not have the same level of technological expertise.

Additionally, providing proper training and support can be costly, particularly for small or underfunded educational institutions. This can make it difficult for these institutions to invest in the necessary resources and support to effectively implement and use cloud-based resources. To overcome this challenge, educational institutions should invest in providing proper training and support for their educators and students. This could include providing professional development opportunities for educators on how to use cloud-based resources, as well as providing technical support for educators and students who are having difficulty using these resources. Additionally, educational institutions should also consider partnering with technology companies or other organizations that can provide training and support at a reduced cost.

Conclusion

Cloud computing can significantly improve academic performance in several ways such as improving accessibility and flexibility of resources, enhancing collaboration and communication, personalization of learning, and enhancing teacher's ability to track student's performance. Cloud-based resources allow students to access materials and work on projects from anywhere, at any time, as long as they have an internet connection. It allows for greater flexibility and accessibility, improved student engagement and motivation, better collaboration among students and teachers, and providing access to a wide range of resources and tools. Cloud computing also allows teachers to access student performance data and provide feedback, which can help them to improve instruction and support student success, and use AI and Machine Learning to personalize learning experiences for students based on their learning style, strengths and weaknesses.

There are several ways to overcome the challenges of using cloud computing in education. One way is to invest in providing students and educators with access to the necessary technology and internet connections. This could include providing laptops or tablets to students who do not have access to their own devices, as well as investing in internet

infrastructure in areas where it is needed. Additionally, educational institutions should also work with community organizations and local governments to increase access to technology and internet connections in underprivileged areas. Another way to overcome challenges is to provide proper training and support for educators and students. This could include providing professional development opportunities for educators on how to use cloud-based resources, as well as providing technical support for educators and students who are having difficulty using these resources. Additionally, educational institutions should also consider partnering with technology companies or other organizations that can provide training and support at a reduced cost. Educational institutions should also prioritize security and privacy when implementing cloud-based resources. This could include implementing strict security protocols and use robust encryption methods to protect sensitive data. Additionally, they should also conduct regular security audits and assessments, to ensure that their data is protected. Furthermore, they should also ensure that the cloud provider they are using is compliant with the regulations and has a good track record of security. Another strategy to overcome the challenges is to collaborate and share resources with other institutions. This could include sharing best practices and resources, as well as pooling resources to provide training and support. Additionally, institutions should also consider partnering with technology companies or other organizations that can provide resources and support at a reduced cost.

It is important to consider the needs of the students and educators when implementing cloud-based resources. This could include gathering feedback and input from students and educators to ensure that resources are meeting their needs and are easy to use. Additionally, institutions should also consider offering flexible options for students and educators, such as the ability to access resources from anywhere and at any time, to ensure that they can work at their own pace and on their own schedule. Effective use of cloud computing in education involves identifying and utilizing the right tools and resources that align with the specific needs of students and teachers. This includes providing proper training and support to ensure that educators and students are able to use cloud-based resources effectively. Additionally, it involves prioritizing security and privacy when implementing cloud-based resources, and regularly assessing the effectiveness of the resources being used. Furthermore, it involves collaborating and sharing resources with other institutions, and considering the

needs of the students and educators when implementing cloud-based resources. It is also important to have a clear strategy and plan for how to use cloud computing in education, and to continually evaluate and adjust it as needed.

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