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# Cloud Literacy Among First-Semester Students: A Survey on Awareness, Usage, And Challenges

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## Abstract

Cloud computing has become an essential component of modern education, enabling students to access, store, and share academic resources efficiently. However, the level of cloud literacy among students, particularly first-semester students, remains uncertain, potentially affecting their ability to maximize its benefits. This study investigates the awareness, usage patterns, and challenges faced by first-semester students in utilizing cloud services. A quantitative survey was conducted among 148 students from various Malaysian Polytechnic and Community College (PolyCC) institutions. The results indicate that while most students are familiar with basic cloud functionalities, many lack proficiencies in advanced features such as data security, multi-platform integration, and collaborative tools. This gap in cloud literacy may hinder students' academic performance and readiness for technology-driven workplaces. The findings emphasize the need for structured cloud literacy training in educational curricula to enhance students' digital competencies. This study concludes by recommending strategic curriculum integration of cloud computing to equip students with the necessary skills for academic and professional success.

**Keywords:** Cloud literacy; cloud services; digital tools; student awareness; education technology

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## I. INTRODUCTION

The integration of cloud computing into education has revolutionized how academic resources are accessed, managed, and shared. Cloud-based platforms such as Google Drive, Microsoft OneDrive, and Dropbox have become essential tools for students and educators, enabling real-time collaboration, document storage, and data sharing. The COVID-19 pandemic accelerated the adoption of cloud technologies, as educational institutions worldwide shifted to remote and hybrid learning models [1]. This transition highlighted the critical role of cloud literacy in ensuring equitable access to education and fostering academic success.

Cloud literacy refers to the ability to effectively use cloud-based tools and services for academic and professional purposes. It encompasses not only technical skills but also an understanding of data security, privacy, and collaborative workflows. Research by Korucu [2] Cloud technologies can

provide flexibility, cost-effectiveness, and support collaboration in education, but security and internet dependence are concerns. Wang and Liu [3] found that students often lack proficiency in advanced functionalities, such as multi-platform integration and version control, which are essential for maximizing the benefits of cloud computing.

Moreover, Ali [4] identified privacy and security concerns are significant barriers to cloud adoption in higher education, highlighting the need for improved cloud literacy. These findings underscore the need for educational institutions to address the cloud literacy gap through targeted interventions and curriculum enhancements. In addition, according to Junaedi et al. [5] the digital divide and lack of access to high-speed internet exacerbates disparities in digital and technology literacy, particularly in developing regions.

## II. LITERATURE REVIEW

The importance of cloud literacy extends beyond academic settings. Studies from Wang [13] indicate that cloud e-learning can improve learning outcomes, particularly in theoretical subjects. As the global workforce increasingly relies on cloud-based tools for collaboration and productivity, students who lack proficiency in these technologies may face disadvantages in the job market. According to a study by Billionniere and Meyer [6], Higher education institutions need to prioritize cloud literacy training to upskill students and professionals due to the rapid increase in cloud technology demand.

While cloud computing has been widely integrated into educational settings, first-semester students often face challenges in adopting these technologies effectively. Moreover, Ibrahim [7] that cloud computing can transform ICT infrastructure in educational institutions, but challenges like data security remain. This study aims to examine the cloud literacy levels of first-semester students in Malaysian Polytechnics and Community Colleges, focusing on their awareness, usage patterns, and challenges in utilizing cloud services.

The adoption of cloud computing among first-semester students is hindered by several challenges. Higher education institutions need to train students and upskill professionals to utilize the increasing range of cloud technology functionalities. According to Wang [12], many institutions face challenges in effectively implementing cloud computing due to a lack of awareness and inadequate training programs aimed at enhancing cloud literacy. Furthermore, technical barriers also contributed to limited access to reliable devices and internet connectivity restricts students' ability to use cloud services consistently. emphasize that inadequate internet infrastructure remains a critical challenge for institutions in developing countries, hindering the effective use of cloud-based educational tools [8].

Concerns about data breaches and unauthorized access remain significant for students, particularly when using free or public cloud services. These worries are often heightened by insufficient knowledge about effective data protection practices. Khalid and Zolkipli [9] point out that security concerns over data protection and privacy in cloud services can hinder adoption in the education sector. Additionally, Alharbi and Tassaddiq [10] identify that students often lack adequate knowledge about cybersecurity practices, leading to potential data breaches and digital misconduct. Resistance to change plays a significant role in the adoption of new educational technologies.

Another challenge is that students often exhibit reluctance to embrace digital learning tools and online teaching methods. Voigt et al. [11] and Ambalov [12] emphasize that resistance to change plays a significant role in the adoption of new educational technologies. Students often exhibit reluctance to embrace digital learning tools and online teaching methods. Despite awareness of digital learning's importance, Çaro (Kola) et al., [13] notes that students face psychological and infrastructural challenges that hinder their perceived readiness and willingness to engage with these tools.

Recent studies have explored cloud computing adoption in Malaysian education, revealing both opportunities and challenges. At the pre-tertiary level, Jotheehwaray Manimaran et al., [19] mention factors such as network connectivity, data security, and budget constraints influence adoption. According to Hussein and Hilmi [20] and Amron et al. [21] in higher education, perceived usefulness and ease of use are significant predictors of cloud-based e-learning adoption. Furthermore, Noh and Amron [22] the COVID-19 pandemic has accelerated the digitization of education, increasing the relevance of cloud computing. However, user readiness remains a concern, with optimism and innovativeness positively affecting acceptance, while insecurity negatively impacts perceived usefulness. Despite these insights, there is still a need for further research on cloud computing adoption among first-semester students in developing countries like Malaysia, as existing studies have primarily focused on broader student populations or professionals in higher education settings. This study aims to address these gaps by examining the cloud literacy levels of first-semester students in Malaysian Polytechnics and Community Colleges. The specific objectives are:

- i. To assess students' awareness of cloud computing services: Understanding their familiarity with cloud platforms and their functionalities.
- ii. To analyze usage patterns and frequency of cloud service adoption: Exploring how students use cloud services for academic purposes.
- iii. To identify challenges faced in utilizing cloud platforms: Investigating technical, security, and accessibility barriers to cloud adoption.
- iv. To provide evidence-based recommendations for curriculum enhancements: Proposing strategies to integrate cloud literacy training into educational programs.

By addressing these objectives, this research aims to contribute to the growing body of knowledge on digital literacy in education and provide actionable

insights for policymakers and educators. To address these issues, Kuhn [14] and Bala [15] students require support and guidance in redesigning their personal learning environments and developing digital competencies.

Lastly, the digital divide in higher education presents significant challenges for students. Faloye et al., [16] students with limited prior exposure to technology often struggle with basic computer tasks, online research, and application usage, impacting their academic performance. This divide can slow down information literacy training and necessitate teaching basic computer skills alongside more advanced concepts. However, Mphahlele et al. [17] point out that the prevalence of social media may help mitigate some effects of the digital divide. To address these challenges, Gulzar et al. [18] emphasized that institutions should prioritize digital literacy and computer skills in and promote technology ownership, especially in disadvantaged areas. These challenges highlight the need for targeted interventions to address the barriers to cloud adoption among first-semester students.

### III. RESEARCH METHODOLOGY

This study employed a quantitative research design utilizing an online survey to assess cloud literacy levels among first-semester students. A structured questionnaire was developed, covering three core areas:

- i. Demographic Information: Student background, device accessibility, and internet reliability.
- ii. Awareness and Usage Patterns: Familiarity with cloud services, frequency of use, and preferred platforms.
- iii. Challenges in Cloud Adoption: Technical, security, and accessibility issues.

A total of 148 first-semester students from PolyCC institutions participated in this study. The participants were selected through purposive sampling, ensuring a representative mix across various academic disciplines. Inclusion criteria required participants to be newly enrolled first-semester students with access to at least one digital device (e.g., smartphone, tablet, or laptop). Access to the internet was a key variable in this study, as it influences students' ability to use cloud computing services effectively. The distribution of internet accessibility among participants is summarized in Table 1. These findings highlight the diverse internet accessibility conditions among students, which can impact their cloud literacy and ability to engage with digital learning tools.

**Table 1**

Internet Access Type	No. of students	Percentage (%)
Home Access Only	33	22.4
Institution Access Only	20	13.6
Both Home & Institution Access	75	51.0
Mobile Data Only	59	40.1
Limited or No Internet Access	10	6.8

Data collection was conducted using an online survey, distributed via institutional email lists and student portals. The survey was structured into three key sections:

- i. Demographic Information – Collected details about students' academic background, access to digital devices, and internet connectivity.
- ii. Awareness and Usage of Cloud Services – Measured familiarity with cloud tools, frequency of use, and primary purposes for adoption.
- iii. Challenges in Using Cloud Services – Identified barriers such as lack of training, security concerns, and internet limitations.

To ensure data reliability, internal consistency was measured using Cronbach's Alpha ( $\alpha = 0.86$ ), indicating a high level of reliability. Data was analysed using SPSS software, using descriptive statistics to summarize key variables, including mean scores, frequency distributions, and standard deviations.

The study surveyed 148 first-semester students from multiple Polytechnic and Community College (PolyCC) institutions across Malaysia. The demographic breakdown of the participants is presented in the Table 2 below:

**Table 2**

Program	No. of students	Percentage (%)
Engineering	32	21.6
Information Technology	34	23.0
Business Management	27	18.4
Others	55	37.0

Students were enrolled in a variety of programs, with Information Technology (23%) and Engineering (21.6%) being the most represented. These programs often require frequent use of digital tools and cloud platforms, making cloud literacy particularly important for these students. Business Management (18.4%) and other programs (37%) also

constituted a significant portion of the sample, highlighting the diverse academic backgrounds of the participants.

Table 3 reveal that 55.4% of students have reliable internet access both at home and at their educational institution, enabling consistent use of cloud services for academic purposes. However, a significant portion of students (37.8%) rely solely on mobile data, which may limit their ability to use cloud platforms effectively due to data costs, slower speeds, and connectivity issues. According to Rahiem [23] while cloud platforms and smart devices have facilitated online learning, many students face technological barriers such as device issues, unstable internet connections, and data costs. Additionally, 23.0% of students have internet access only at home, while 13.5% have access only at their institution, creating challenges when they are in locations without Wi-Fi. Salsbury & Hansen [24] mention that to address this digital divide, some institutions have implemented solutions such as loaning Wi-Fi hotspots to students with high need. A small but notable percentage of students (6.8%) reported having limited or no internet access, highlighting the digital divide that exists even within educational institutions. Limited internet access has been shown to negatively affect learning processes, motivation, and self-efficacy. According to Zilka et al. [25], inadequate internet connectivity poses a significant barrier to effective learning, particularly in environments that rely heavily on cloud-based educational tools.

**Table 3**

Internet Access	No. of students	Percentage (%)
Home	34	23.0
Institution	20	13.5
Home and Institution	82	55.4
Mobile data only	56	37.8
Limited or no internet access	10	6.8

In this study, the accessibility of various devices among students was analyzed to understand their technological resources. Table 4 shows that 100% of students reported having regular access to a smartphone, highlighting its ubiquity as a primary device. Additionally, 55.4% of students had access to a laptop, while 37.8% owned or used a tablet. Desktop computers were less common, with only 23.0% of students having access to them. These findings underscore the prevalence of portable devices like smartphones and laptops, which are likely to play a significant role in students' academic activities, particularly in accessing cloud services and other

digital tools. The results suggest that while smartphones are universally accessible, there is variability in access to other devices, which may influence students' ability to engage with certain technologies or platforms. However, Sage et al. [27] students generally perceive laptops as more educationally valuable than smartphones. Elliot [28] point out that students and those with financial constraints tend to rely more heavily on smartphones for a wider range of learning activities.

**Table 4**

Device	No. of students	Percentage (%)
Smartphone	148	100.0
Laptop	82	55.4
Desktop	34	23.0
Tablet	56	37.8

Data on students' internet access patterns were collected and analysed to assess their ability to engage with digital tools and cloud services. Table 5 shows that 55.4% (82 students) reported having access to stable Wi-Fi, indicating that a majority of respondents rely on consistent and reliable internet connections for their academic and personal activities. This group is likely to experience fewer disruptions when accessing online resources, collaborating on cloud platforms, or participating in virtual learning environments. Stable Wi-Fi access is a critical factor in ensuring seamless integration of technology into education, as it enables students to fully utilize digital tools without connectivity-related challenges. To address these issues, Mnisi et al. [29] and Manu et al. [30] recommended to include installing pocket Wi-Fi devices in classrooms, prioritizing community technology centers, and providing subsidized internet access and devices to low-income students.

However, 37.8% (56 students) depend on mobile data for internet access, which may introduce limitations such as data caps, slower speeds, or inconsistent connectivity. This reliance on mobile data suggests that a significant portion of students may face difficulties when engaging in data-intensive tasks, such as uploading large files or participating in real-time collaborative activities. According to Hampton et al. [31], students without home internet access or relying solely on mobile data perform lower on various metrics, including digital skills, homework completion, grades, and standardized test scores. Additionally, 6.8% (10 students) reported having limited or no internet access, which could significantly hinder their ability to participate in online learning or utilize cloud-based services. These findings highlight the variability in internet access among students and

underscore the importance of addressing connectivity disparities to ensure equitable access to digital resources. This analysis forms a critical part of the methodology, as it provides insights into the technological challenges faced by students and informs recommendations for improving accessibility in a technology-driven educational landscape.

**Table 5**

Device	No. of students	Percentage (%)
Stable Wi-Fi	82	55.4
Mobile data	56	37.8
Limited or No Internet Access	10	6.8

Data collection was conducted using an online survey, which was distributed social media applications. The survey was designed to be user-friendly and accessible, ensuring that students could complete it within 10–15 minutes. The questionnaire was structured into three key sections, each focusing on specific aspects of cloud literacy. Demographic Information collected details about students' academic background, including their program of study, institution, and year of enrolment. It also gathered information on students' access to digital devices (e.g., smartphones, laptops, tablets, desktop computers) and their internet connectivity (e.g., home Wi-Fi, institutional Wi-Fi, mobile data, or limited/no internet access). This data was crucial for understanding the technological resources available to students and how these resources might influence their ability to use cloud services effectively.

In the Awareness and Usage of Cloud Services section it measured students' familiarity with cloud computing concepts and platforms. Questions assessed their knowledge of popular cloud services such as Google Drive, Microsoft OneDrive, iCloud, and Dropbox. Students were asked about the frequency of their cloud service usage (e.g., daily, weekly, monthly, rarely, or never) and the primary purposes for which they used these services (e.g., file storage, file sharing, real-time collaboration, or document organization). This section also explored students' proficiency in using advanced cloud features, such as setting permissions for shared files, troubleshooting common issues, and collaborating on documents in real-time.

For the Challenges in Using Cloud Services section it identified barriers students faced when using cloud platforms. Questions focused on challenges such as lack of knowledge or training, difficulty in understanding cloud features, privacy and security

concerns, file management problems, and internet connectivity issues. Students were also asked whether they had received any formal training on cloud services and, if so, where they received it (e.g., high school, TVET institution, online courses, or self-taught). Additionally, this section explored students' confidence levels in protecting their data when using cloud services and their perceptions of the importance of cloud services for their studies.

The survey was distributed to first-semester students across multiple Malaysian Polytechnic and Community College (PolyCC) institutions. To ensure a representative sample, purposive sampling was used, targeting students from various academic disciplines, including Information Technology, Engineering, Business Management, and others. The survey was open for a period of four weeks, and reminders were sent to encourage participation. A total of 148 responses were collected, providing a robust dataset for analysis.

The collected data was analyzed using SPSS software, following a multi-step approach to ensure comprehensive and accurate results. Descriptive statistics were used to summarize the key variables in the study. This included calculating mean scores, frequency distributions, and standard deviations for students' awareness, usage patterns, and challenges related to cloud services. Inferential statistical tests, such as Chi-square tests and ANOVA, were conducted to examine differences in cloud literacy based on demographic factors. For instance, the study explored whether students from different academic programs (e.g., Information Technology vs. Engineering) had significantly different levels of cloud literacy. These tests also examined the relationship between internet accessibility (e.g., stable Wi-Fi vs. mobile data) and students' ability to use cloud services effectively.

Pearson correlation tests were performed to analyze the relationship between students' digital literacy levels and their frequency of cloud service usage. This helped determine whether students with higher digital literacy were more likely to use cloud services regularly and effectively. Additionally, correlations were explored between students' confidence in data protection and their awareness of cloud security features.

To ensure the reliability of the survey instrument, internal consistency was measured using Cronbach's Alpha. The calculated value ( $\alpha = 0.86$ ) indicated a high level of reliability, confirming that the survey questions consistently measured the intended constructs. Content validity was ensured by reviewing the survey questions with experts in cloud computing and education technology before distribution.

The study adhered to ethical research practices, including obtaining informed consent from

participants and ensuring the confidentiality of their responses. Participants were informed that their participation was voluntary and that they could withdraw from the study at any time without penalty. Data was anonymized to protect students' identities, and the results were reported in aggregate form to prevent the identification of individual respondents.

#### IV. RESULT DAN DISCUSSION

The survey results revealed that a significant portion of students were familiar with cloud services, with 42.6% reporting being very familiar and 37.2% somewhat familiar (Table 6). Similarly, a survey by Atikuzzaman and Islam [32] found that most first year students is also familiar with cloud services, using them primarily for storage, backup, and collaboration. However, 20.3% of students were not familiar with cloud services, indicating a gap in awareness that needs to be addressed. Study from Dubey and Tiwari [33] revealed limited adoption due to lack of curriculum integration, unawareness of free trials, and concerns about costs and account management. These findings highlight the need for increased awareness and education about cloud services in academic settings to better prepare students for cloud-based environments.

**Table 6**

Familiarity with Cloud Services	No. of students	Percentage (%)
Very familiar	63	42.6
Somewhat familiar	55	37.2
Not familiar	30	20.3

In terms of usage, Google Drive was the most popular cloud service, with 90.5% of students reporting its use (Table 7). Research by Romero et al. [34] has demonstrated that Google Drive enhances collaborative work, with 92% of students in one study agreeing that it helped achieve learning objectives. This is likely due to its widespread availability and integration with other Google tools, such as Gmail and Google Docs. Microsoft OneDrive was used by 45.9% of students, while iCloud and Dropbox were used by 31.8% and 4.7%, respectively. It is important to note that students were able to select more than one cloud service, reflecting the diverse range of tools they utilize for different purposes. A small but notable group (2.7%) had never used any cloud services, suggesting that some students may lack access to or awareness of these tools. Additionally, research by Banerjee [35] has identified disparities in technological access and efficacy among underserved

and underrepresented student populations, which can impact their ability to engage with online learning platforms. These findings highlight the need for institutions to address the digital divide, raise awareness about cloud services, and develop strategies to support equitable access and adoption of technology in higher education settings.

**Table 7**

Cloud Services	No. of students	Percentage (%)
Google Drive	134	90.5
Microsoft OneDrive	68	45.9
iCloud	47	31.8
Dropbox	7	4.7
Other	24	16.2
Never Used Cloud	4	2.7

The frequency of cloud usage varied among students, with 33.1% using cloud services daily and 31.8% using them weekly (Table 8). However, 20.8% used cloud services monthly, and 14.2% rarely or never used them, indicating that a significant portion of students do not rely on cloud tools regularly. This could be due to a lack of understanding of the benefits of cloud services or challenges in accessing reliable internet and devices. According to Alimboyong and Bucjan [36], cloud computing adoption in e-government and higher education faces significant challenges in developing countries. Key issues include slow and unreliable internet connections, lack of understanding or awareness of cloud computing benefits, and insufficient IT infrastructure.

**Table 8**

Cloud Services	No. of students	Percentage (%)
Daily	49	33.1
Weekly	47	31.8
Monthly	31	20.8
Rarely	15	10.1
Never	6	4.1

When asked about their ability to perform specific cloud-related tasks, students reported varying levels of confidence (Table 9). The table presents descriptive statistics for students' confidence levels in performing various cloud-related tasks. The tasks include uploading files to the cloud, organizing files and folders, sharing files with others, collaborating on documents in real-time, setting permissions for shared files, and troubleshooting common cloud issues. The mean scores indicate that students are most confident

in sharing files with others (mean = 2.99) and organizing files and folders (mean = 2.85), while they are least confident in troubleshooting common cloud issues (mean = 2.27). The standard deviations, ranging from 0.808 to 0.910, suggest moderate variability in students' confidence levels across tasks. Overall, the data indicates that while students are relatively comfortable with basic cloud tasks like sharing and organizing, they face challenges with more complex tasks such as troubleshooting and collaborating in real-time, highlighting a potential area for additional training and support. Kolgatin et al. [37] agreed that students recognize the key role of cloud computing in education but struggle with issues like time management, self-motivation, and the need for detailed instructions in remote learning settings.

**Table 9**

Ability	Mean	Standard Deviation
Uploading files to the cloud	2.75	0.910
Organizing files and folders	2.85	0.828
Sharing files with others	2.99	0.808
Collaborating on documents in real time	2.59	0.887
Setting permissions for shared files	2.72	0.881
Troubleshooting common cloud issues	2.27	0.900

The study identified several challenges faced by students in adopting cloud services. The most significant barrier was internet connectivity issues, reported by 49% of students (Table 10). This finding is consistent with previous research by Alimboyong and Bucjan [36], Gupta et al. [38] and Abdelkader et al. [39] highlighting the digital divide in developing countries, where limited access to reliable internet infrastructure hinders the adoption of digital tools [3]. Additionally, 41.2% of students reported difficulty understanding cloud features, and 40.5% cited a lack of knowledge or training as a major challenge. These results underscore the need for structured training programs to enhance students' cloud literacy. To address these challenges, structured training programs are needed to enhance students' cloud literacy and self-management skills. M. Naved et al. [40] suggested educational institutions must carefully consider the sustainability and standardization of cloud services when integrating them into their IT infrastructure.

**Table 10**

Challenges	No. of students	Percent age (%)
Lack of Knowledge/Training	60	40.5
Difficulty Understanding Features	61	41.2
Internet Connectivity Issues	71	49.0
Privacy and Security Concerns	52	35.1
File Management Problems	48	32.4
Other Challenges	24	16.2

Privacy and security concerns were also a significant barrier, with 35.1% of students expressing apprehension about data breaches and unauthorized access (Table 2). This aligns with findings from Balash et al. [41], who identified students worry about the amount and personal nature of information shared, though some recognize a trade-off between safety and exam integrity. Furthermore, 32.4% of students reported file management problems, indicating that organizing and managing files in the cloud is a challenge for some. A smaller group (16.2%) reported other challenges, such as limited storage or device compatibility issues. Technical challenges such as synchronization problems, limited storage, and device compatibility issues are also reported by Shi et al. [42] and Qasim et al. [43].

Students' confidence in protecting their data on cloud services varied widely. While 33.8% were very confident and 27.7% were somewhat confident, a significant portion (23.6%) were neutral, and 10.8% were not confident (Table 11). These results suggest that while many students feel secure using cloud services, a notable group remains uncertain about their ability to protect their data. Another study revealed that users of cloud services have basic awareness of security implications but may lack comprehensive threat models due to limited technical knowledge as highlighted by previous studies Wermke et al.[44].

**Table 11**

Confident Level	No. of students	Percentage (%)
Very Confident	50	33.8
Somewhat Confident	41	27.7
Neutral	35	23.6
Not Confident	16	10.8
Very Not Confident	6	4.1

When asked about the importance of cloud services for their studies, 33.1% of students felt that cloud services were very important, and 27%

considered them somewhat important (Table 12). However, 33.1% were neutral, and 6.8% felt that cloud services were not important. This divergence in perceptions suggests that while many students recognize the value of cloud tools, others may not fully understand their potential benefits or face barriers that limit their use. This also supported by Kholilah et al. [45] the perceived ease of use and facilitating conditions are crucial factors influencing students' intention to use cloud computing, while perceived usefulness, social influence, and personal innovativeness may have less impact. Furthermore, Kholilah et al. [45] indicate that students' intentions to adopt cloud computing are chiefly influenced by the ease of use and the availability of facilitating conditions, whereas factors such as perceived usefulness, social influence, and personal innovativeness seem to play a relatively minor role.

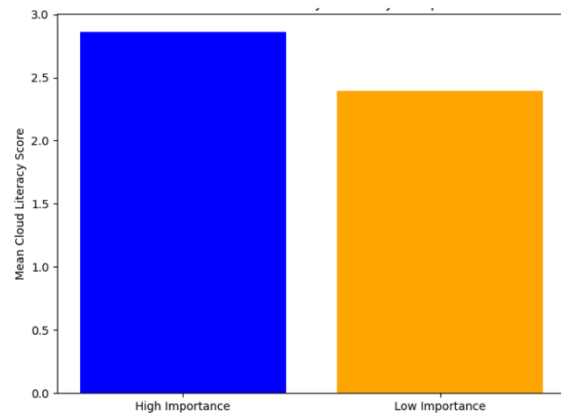
**Table 12**

Perceived Importance	No. of students	Percent age (%)
Very Important	49	33.1
Somewhat Important	40	27.0
Neutral	49	33.1
Not Important	6	4.1
Very Not Important	4	2.7

A strong majority of students (73.5%) expressed interest in receiving additional training on cloud services, as shown in Table 6, while 26.5% were not interested. This high level of interest underscores the demand for further education on cloud tools, particularly in advanced functionalities such as real-time collaboration, data security, and troubleshooting. The increasing demand for cloud-related skills has highlighted the need for comprehensive upskilling and reskilling programs aimed at both students and professionals, as noted by Billionniere and Meyer [46]. The findings suggest that while many students are familiar with basic cloud functionalities, they recognize the need for more comprehensive training to fully leverage these tools for academic and professional purposes. Addressing this demand through targeted training programs could significantly enhance students' cloud literacy, improve their academic performance, and better prepare them for technology-driven workplaces. This aligns with previous research by Tian et al. [47] emphasizing learning and workflow learning are identified as effective methods to align skill development with

digital transformation progress, emphasizing the importance of digital awareness, competency, and fluency.

The analysis of mean cloud literacy scores revealed significant differences between groups based on their perceived importance of cloud skills. As illustrated in Figure 1, students who considered cloud skills to be of high importance had a mean cloud literacy score of 2.5, while those who perceived cloud skills as less important had a mean score of 1.5. This indicates that students who value cloud skills more highly tend to have better cloud literacy, suggesting a positive correlation between perceived importance and actual proficiency.



**Figure 1**

## V. CONCLUSION

Cloud computing has become an essential tool in education, offering a range of functionalities that enhance learning and collaboration. While most students are familiar with basic cloud features such as file storage and sharing, there remains a substantial gap when it comes to advanced skills, particularly in areas like real-time collaboration, multi-platform integration, and data security. The lack of proficiency in these areas can hinder students from fully leveraging cloud technologies to enhance their academic performance. Jackman et al. [48] emphasize the urgent need for coordinated global efforts in digital skills education to help students succeed while mitigating risks. Pellicano et al. [49] report on students' struggles with embedded systems, suggesting a need for more engaging educational tools to enhance competency and real-world application.

Several challenges continue to impede students' adoption of cloud technologies, with internet connectivity issues and limited training opportunities being the most prominent. According to Akmad & Abatayo [50] unstable internet connections, particularly for students relying on mobile data, can severely restrict their ability to access cloud services consistently. These challenges lead to increased stress and negatively affect academic outcomes. Additionally, the lack of formal training on cloud-related skills further complicates students' efforts to utilize these tools effectively. Privacy concerns and difficulties with file management also contribute to the hesitancy toward adopting cloud platforms. These challenges are particularly prevalent in developing regions, where inadequate infrastructure and limited resources exacerbate the digital divide. Addressing these barriers requires targeted interventions aimed at improving internet accessibility and offering comprehensive training programs.

Furthermore, while many students express confidence in performing basic tasks like file storage and sharing, their competence diminishes when engaging with more advanced cloud functionalities. This disparity indicates a pressing need for training that goes beyond foundational skills. Wagemann et al. [51] emphasizing that these efforts aim to develop role-based and technical skills necessary for managing cloud technologies, As the demand for cloud-related skills continues to grow in the workforce, educational institutions must prioritize cloud literacy in their curricula. By enhancing training programs and addressing accessibility issues, institutions can help bridge the gap in digital literacy and better prepare students for future technology-driven workplaces. Effective integration of cloud literacy training would not only enhance students' academic experiences but also improve their readiness to navigate increasingly digital professional environments.

This study investigated the awareness, usage patterns, and challenges faced by first-semester students in utilizing cloud services within Malaysian Polytechnics and Community Colleges. The findings indicate that while most students are familiar with basic cloud functionalities such as file storage and sharing, significant gaps remain in advanced skills, particularly real-time collaboration, multi-platform integration, and data security. These deficiencies may hinder students' academic performance and readiness for technology-driven workplaces.

Furthermore, the research highlights several challenges to cloud adoption, including limited internet connectivity, inadequate training, privacy concerns, and file management issues. Internet connectivity issues were the most prominent barrier, particularly for students relying solely on mobile data.

The findings also reveal a strong demand for additional training, especially in advanced cloud functionalities and data security.

In response to the research objectives, this study emphasizes the need for educational institutions to integrate structured cloud literacy training into their curricula. Addressing the identified gaps and challenges through targeted interventions, such as enhancing internet accessibility and providing comprehensive training programs, will not only enhance students' digital competencies but also improve their readiness for the evolving demands of the digital workforce. Future research should explore the effectiveness of various training methods in improving cloud literacy among students and assess their long-term impact on academic and professional success.

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