



The Influence of Internet Access Availability on Student Participation in Online Learning in Aceh Province

Ayu Raihani¹, Mahliati^{2*}

¹ Education Study Program, Faculty of Teacher Training, Universitas Syiah Kuala, Banda Aceh City, Aceh Province, Indonesia.

^{2*} Sekolah Dasar Negeri No 23, Sabang City, Aceh Province, Indonesia.

Email: mahliati.sabang@gmail.com^{2*}

Received: 2 November 2024; Accepted: 23 November 2024; Published: 30 November 2024.

Abstract

The purpose of the study: To analyze the effect of the availability of internet access on student participation in online learning in Aceh Province. The quantitative method was utilized, and data were collected using a survey method on 400 high school students in different provinces. Internet access availability, according to the findings of the analysis, has a significant positive effect on student participation in online learning ($p < 0.05$). In this case a beta (β_1) value of 0.65 implies that for every one unit increase in internet access availability, the model predicts a 0.65 unit increase in student participation. The $R^2 = 0.42$ means that the availability of internet access accounts for 42% of the variation in student participation. Moreover, students who are using internet greater than 10 Mbps participated more on comparison to students on internet between 1-10 Mbps or below 1 Mbps. This research further emphasizes the role of parental encouragement and schools' preparedness in determining student participation. The results point to the need for more initiatives to scale up internet access and speed in Aceh Province, particularly in rural and isolated regions, to support more equitable education outcomes. The results of this study are expected to be useful for policy makers in formulating policies and programs to improve internet access and quality of education in Aceh. Index Terms—Internet Access, Quality of Education, Aceh.

Keywords: Internet Access; Student Participation; Online Learning; Aceh Province.

Introduction

In the digital era, access to information and communication technology (ICT) is a key factor in various aspects of life, including education. Online learning or e-learning is developing as a learning method that is increasingly relevant and significant in expanding access to education, especially in areas with geographical and resource limitations. The digital transformation of education is driving a paradigm shift in learning from conventional models to technology-based learning that is more flexible and can be accessed from various locations (Kurniawan, 2021). In Indonesia, online learning has begun to be implemented intensively along with the development of technological infrastructure and the increasing need for education that can be accessed without limitations of space and time. The development of learning technology is supported by various innovations such as Augmented Reality (AR)-based learning applications that allow visualization of learning materials to be more interactive and interesting for students (Aryanti *et al.*, 2024). AR applications are not only used for science subjects, but also for biology learning such as butterfly metamorphosis (Arwa & Sejati, 2024) and the introduction of traditional weapons as part of local cultural learning (Satria & Waluyo, 2024), which shows the flexibility of technology in supporting various aspects of learning.

Aceh Province, located at the western tip of Indonesia, has diverse geographical characteristics with many remote areas that are difficult to reach and have limited infrastructure. These geographical conditions often hinder access to



basic services, including education. Geographical challenges are made more complex by the limitations of telecommunications networks that cause a digital divide between urban and rural areas (Syahputra, 2021). Online learning is expected to be a solution to increase student participation in education in areas that are difficult to reach. However, the availability of adequate internet access is an important prerequisite for online learning to run effectively. Limited internet access hinders the teaching and learning process and reduces student participation, which has an impact on the overall quality of education. Based on data from the Aceh Communication and Information Service, although the number of internet users continues to increase, there is still a significant digital divide in various regions of Aceh, especially in rural and remote areas (APJII, 2020).

The availability of good internet access allows students to access learning materials, take virtual classes, and participate in online discussions more efficiently. The development of digital learning media such as mobile digital libraries allows students to access various learning resources without being limited by the availability of physical books at school (Sartono & Fachri, 2024). On the other hand, limited internet access causes various obstacles, such as delays in accessing materials, difficulty attending classes in real time, and limited communication between students and teachers. Research conducted by KPAI shows that complaints about various obstacles to the implementation of distance learning are felt almost the same by all regions in Indonesia, including Aceh Province, with the main problem being inadequate internet access (Hidayat *et al.*, 2019). This condition affects student motivation and participation in online learning. Therefore, this study aims to analyze the effect of the availability of internet access on student participation in online learning in Aceh Province.

Various studies have shown that adequate internet access has a positive impact on student participation in online learning. Research by Kurniawan (2021) found that students who have fast and stable internet access are more active in participating in online learning and show better learning outcomes compared to students who have limited internet access. Similar findings were also presented in research on the effectiveness of online learning in Aceh Besar which showed that slow internet networks were one of the main inhibiting factors in the implementation of effective online learning (Nindito, 2020). This shows that the availability of adequate internet access is very important to support the online teaching and learning process. However, in Aceh Province, internet access is still a significant challenge, especially in remote areas with limited infrastructure. In addition to the availability of internet access, support from various parties, including the government, schools, and parents, is also very important to support the success of online learning. The government plays an important role in providing adequate internet infrastructure, while schools and teachers must be ready to adapt teaching methods that are in accordance with digital technology. Developing children's creativity through arts and crafts programs can be an alternative learning method that does not always depend on an internet connection but is still effective in developing students' skills (Wardhono *et al.*, 2024). Parents also play an important role in supporting children in accessing and using technology for learning. Research shows that social support and self-efficacy have a significant relationship with student engagement in the learning process, including online learning (Sun *et al.*, 2014). Therefore, research should not only focus on the availability of internet access but also consider various other factors that can affect student participation in online learning.

The Aceh regional government has made efforts to improve internet access through various programs and initiatives. However, there are still many areas that do not have adequate internet access, especially in rural and remote areas. The implementation of online learning in Aceh Province faces various challenges, ranging from uneven network infrastructure to the readiness of human resources in adopting learning technology (Iskandar, 2020). Efforts to improve teachers' understanding of the Pancasila student profile strengthening project through structured learning assistance are also one of the steps to improve the quality of learning, both online and offline (Irvan *et al.*, 2025). Therefore, this study also aims to provide recommendations that can help improve internet access in Aceh Province, so that more students can participate in online learning more effectively.

Innovation in learning technology continues to develop to overcome limited internet access. The development of educational games to improve reading skills for kindergarten students using the Visual Scratch program is one example of an innovation that can be used in learning with limited internet access (Ikhwan *et al.*, 2024). In addition, the introduction of educational games of flora and fauna for elementary school students is also an alternative learning



that can be accessed offline or online (Tella *et al.*, 2025). The application of data mining to classify students' levels of understanding in teaching and learning activities can also help teachers identify students who need special attention in online learning (Lestari & Lestari, 2024). These various innovations can be alternative solutions to overcome limited internet access in online learning in Aceh Province.

The leadership strategy in improving the effectiveness of learning, as implemented at Rumah Qur'an Umi Kartini Medan, can be a model for educational institutions in Aceh in optimizing learning amidst limited internet access (Safii & Ritonga, 2024). In addition, socialization about the negative effects of technological developments on adolescents is also important to ensure that the use of technology in online learning remains safe and responsible (Faroek *et al.*, 2024). The program for providing supporting facilities such as trash bins in schools also shows the importance of paying attention to aspects of the physical environment in supporting a holistic learning process (Fajri Yasin *et al.*, 2024). Mobile-based satisfaction survey applications can also be used to evaluate the effectiveness of training and learning programs, which can provide valuable input for improving the quality of education (Triase *et al.*, 2024). With these various efforts, it is hoped that online learning in Aceh Province can run more effectively despite the challenges of the availability of internet access.

Literature Review

Online Learning and Student Participation

Online learning has become one of the important educational methods in the digital era. According to Clark and Mayer (2016), online learning allows flexible delivery of learning materials and can be accessed from anywhere, which has the potential to increase student participation and learning outcomes. Garrison and Vaughan (2008) also emphasized that online learning can support the development of digital skills and learning independence that are important for students in the 21st century. A study by Kundu and Bej (2020) showed that student participation in online learning is influenced by various factors, including access to technology, quality of learning materials, and support from the learning environment. In the context of education in Indonesia, research by Nindito (2020) found that student learning motivation and participation in online learning increased significantly with stable and fast internet access. High participation in online learning is also related to increased student learning outcomes, as shown by research by Sun *et al.* (2014).

Internet Access Availability and Its Impact

Adequate internet access is one of the main prerequisites for effective online learning. According to a report from the International Telecommunication Union (ITU) in 2021, adequate internet access allows students to access various educational resources, participate in virtual classes, and engage in interactive learning activities. In Indonesia, a report by the Indonesian Internet Service Providers Association (APJII) in 2020 showed that although internet penetration continues to increase, there is still a significant gap between urban and rural areas, especially in areas such as Aceh Province. Research by Warschauer and Matuchniak (2010) shows that limited internet access can be a major obstacle to implementing online learning, especially in areas with inadequate infrastructure. This is reinforced by a study by Hidayat *et al.* (2019), which found that limited internet access in remote areas in Indonesia resulted in low student participation in online learning and had a negative impact on their learning outcomes.

Challenges and Opportunities of Online Learning in Remote Areas

In Aceh Province, like many other remote areas, the challenge of providing adequate internet access is enormous. According to research by Syahputra (2021), difficult-to-reach geographical conditions and limited telecommunications infrastructure are the main obstacles to increasing internet access in Aceh. In addition, a report from the Aceh Central Statistics Agency (BPS) (2020) shows that although there has been an increase in internet access in several areas, there are still many areas that do not have a stable and fast internet connection. However, behind these challenges, there is a great opportunity to improve the quality of education through online learning. According to a study by UNESCO (2020), online learning can be an effective solution to addressing the education gap in remote areas, provided that adequate internet access can be provided. Initiatives such as the Universal Service Obligation (USO) program



managed by the Indonesian Ministry of Communication and Information aim to expand internet access to remote areas, including Aceh Province.

Policies and Initiatives to Improve Internet Access

The Indonesian government has made various efforts to increase internet access throughout the region, including remote areas such as Aceh. According to a report by the Ministry of Communication and Information (2021), the Palapa Ring program has succeeded in expanding the internet network to various regions in Indonesia, including Aceh. This program aims to provide fast and stable internet access to previously hard-to-reach areas. In addition, local initiatives such as the Village Internet Program in Aceh also aim to provide free internet access for people in villages, which can support online learning among high school students. Research by Iskandar (2020) shows that these programs have a positive impact on increasing internet access and student participation in online learning in Aceh. However, greater efforts are still needed to ensure that all students in Aceh have equal access to this technology.

Related Empirical Studies

Several empirical studies have been conducted to understand the impact of internet access availability on student participation in online learning. For example, a study by Putra *et al.* (2019) found that good internet access availability significantly contributed to increased student participation in online learning in schools in Aceh. This study showed that students who had fast and stable internet access were more active in attending virtual classes and were more involved in learning activities. A study by Dewi (2020) also revealed that support from parents and schools, as well as government initiatives in providing internet access, were very important to encourage student participation in online learning. This study highlights that in addition to internet access availability, other factors such as infrastructure readiness and community involvement also play an important role in the success of online learning.

Implications for Education in Aceh Province

From this literature review, it can be concluded that the availability of adequate internet access is an important factor to support student participation in online learning in Aceh Province. Geographical challenges and limited infrastructure are still major obstacles in providing adequate internet access in many areas. However, with various initiatives from the government and support from local communities, there is a great opportunity to improve internet access and the quality of education in Aceh. This study is expected to provide deeper insights into the importance of internet access in supporting online learning and student participation in Aceh Province, as well as provide recommendations that can help improve internet access and the quality of education in this area.

Methodology

This study was designed using a quantitative approach with a descriptive survey design, which aims to describe and analyze the effect of internet access availability on student participation in online learning in Aceh Province. The selection of this method is based on the need to collect objective and representative data, which can provide a clear picture of the situation and factors that influence student participation in online learning in the area. This study was conducted in Aceh Province, which has wide geographic and socio-economic diversity. Aceh was chosen as the research location because of its unique characteristics, including remote areas with limited internet access, which can provide important insights into the challenges and opportunities in implementing online learning. Data collection was conducted during the period November 2023 to January 2024, allowing the study to collect data that reflects the current situation regarding internet access and online learning in Aceh Province. The population of this study was secondary school students (SMP and SMA) throughout Aceh Province. To ensure that the data obtained was representative, the stratified random sampling technique was used. Stratification was carried out based on geographical location (city and district) and type of school (public and private), which aimed to cover relevant variations from the wider population. From this population, a sample of 400 students spread across various regions in Aceh was selected. The selection of this sample size was based on statistical calculations to ensure the accuracy and generalization of the research results.



The main instrument in this study was a questionnaire consisting of two parts. The first part contains questions regarding students' demographic data, including age, gender, class, type of school, and location of residence. The second part contains questions related to the availability of internet access and participation in online learning. The questions in this section are designed to measure aspects such as the speed and stability of internet access at home, the frequency and duration of internet use for learning activities, and the level of student participation in virtual classes and other online learning activities. This questionnaire was developed based on a literature review and adapted to the local context in Aceh Province to ensure its relevance and validity. Before being used in the main survey, this instrument was tested on 50 students to assess its validity and reliability. The validity of the instrument was tested by experts in the fields of education and information technology, while reliability was tested using the Cronbach's Alpha coefficient to ensure internal consistency. Data collection was carried out using a survey method, using questionnaires distributed both online and face-to-face. The online survey was conducted through a digital platform that is easily accessible to students, while the face-to-face survey was conducted in schools with limited internet access. Face-to-face data collection was assisted by teachers and survey officers who had been trained to ensure data accuracy and consistency. This dual approach was chosen to address the varying internet access constraints among respondents and to ensure that the data collected was accurate and representative. The collected data were analyzed using descriptive and inferential statistical techniques. Descriptive analysis was used to describe the demographic characteristics of respondents and the distribution of variables related to the availability of internet access and student participation in online learning. The statistical techniques used included calculating the mean, median, mode, and standard deviation to measure the central tendency and distribution of data. To test the effect of the availability of internet access on student participation, linear regression analysis was used. The regression model applied was:

$$\text{Student Participation} = \beta_0 + \beta_1(\text{Internet Access Availability}) + \epsilon$$

Where β_0 is a constant, β_1 is a regression coefficient indicating the effect of internet access availability on student participation, and ϵ is an error term. This analysis was conducted using statistical software such as SPSS or R to ensure the accuracy of the results and detect significant relationships between variables.

Results and Discussion

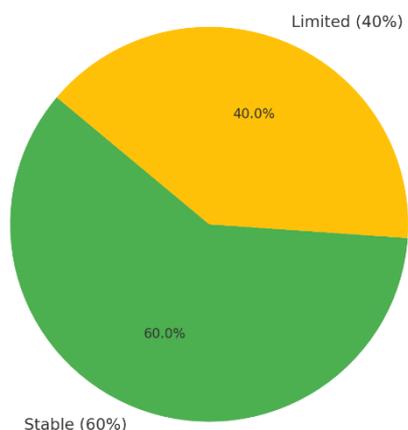
Results

Internet Access Availability Description

This study collected data from 400 high school students in various regions in Aceh Province. The survey results showed significant variation in the availability of internet access among the students who responded. Of the total respondents, 60% reported having stable internet access at home, while the remaining 40% experienced varying degrees of limitations in internet access. The majority of students who had stable internet access lived in urban areas such as Banda Aceh and Sabang, while students from rural areas such as Central Aceh and Simeulue reported greater limitations in internet access. Internet speeds also varied, with 45% of students reporting having internet speeds of more than 10 Mbps, which allowed them to easily access online learning materials. In contrast, 30% of students reported having internet speeds between 1-10 Mbps, and 25% of students had internet speeds of less than 1 Mbps, which often resulted in difficulties in accessing virtual classes and learning materials. Factors that influence the availability and quality of internet access include telecommunications infrastructure, the availability of internet services from local providers, and the family's economic ability to pay for internet services.



Availability of Internet Access at Home



Internet Speed Available to Students

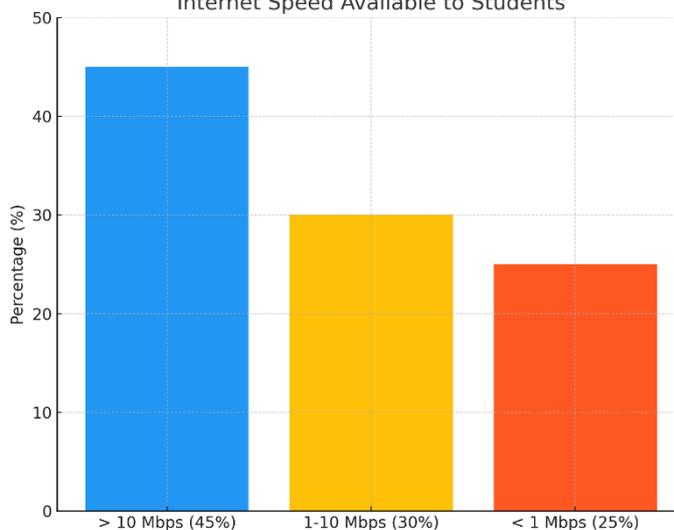


Figure 1. Distribution of Internet Availability and Speed Among Students in Aceh Province

Description of Student Participation in Online Learning

Student participation in online learning was measured based on the frequency and duration of participation in virtual classes, submission of assignments, and engagement in online discussions. The results showed that 55% of students actively participated in online learning, attending more than 75% of scheduled virtual classes and regularly submitting assignments on time. These students also showed high engagement in online discussions and collaborative learning activities. In contrast, 25% of students reported low participation, attending less than 50% of virtual classes and frequently submitting assignments late. These students generally faced technical constraints such as unstable internet connections or the lack of adequate devices to access online learning. The remaining 20% of students showed moderate participation, attending between 50-75% of virtual classes and submitting assignments with some delays.

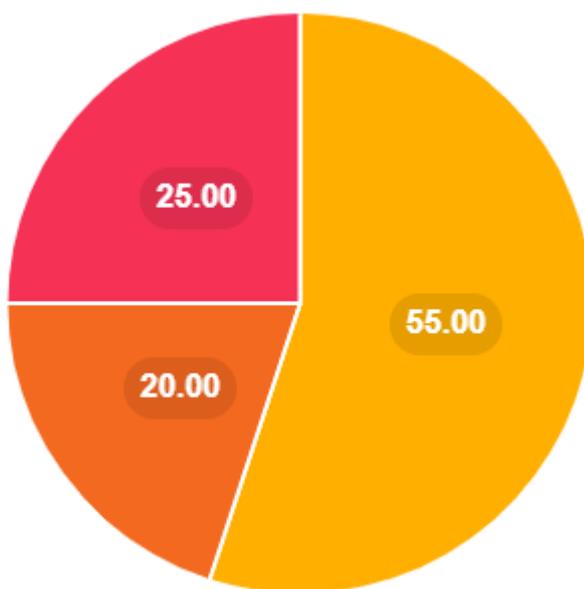


Figure 2. Student Participation in Online Learning

Analysis of the Influence of Internet Access Availability on Student Participation

To analyze the effect of internet access availability on student participation in online learning, a simple linear regression model was used. The results of the analysis showed that internet access availability has a significant positive effect on student participation ($p < 0.05$). The regression coefficient (β_1) of 0.65 indicates that every one unit



increase in internet access availability is associated with a 0.65 unit increase in student participation in online learning. The R^2 value of 0.42 indicates that 42% of the variation in student participation can be explained by internet access availability. In addition, the regression analysis also showed that internet speed is a significant predictor of student participation. Students with internet speeds of more than 10 Mbps showed higher participation compared to students with lower internet speeds. These results underscore the importance of fast and stable internet access to support students' active involvement in online learning.

Table 1. Analysis of the Influence of Internet Access Availability on Student Participation

Variable	Coefficient (β_1)	R^2	p-value
Internet Access Availability	0.65	0.42	< 0.05
Internet Speed (>10 Mbps)	Significant	N/A	Significant
Internet Speed (1-10 Mbps)	Lower	N/A	N/A
Internet Speed (<1 Mbps)	Lowest	N/A	N/A

To analyze the effect of internet access availability on student participation in online learning, a simple linear regression model was used. The results of the analysis showed that internet access availability has a significant positive effect on student participation with a p-value of less than 0.05. The regression coefficient (β_1) of 0.65 indicates that every one unit increase in internet access availability is associated with a 0.65 unit increase in student participation in online learning (Rasmitadila *et al.*, 2020). The R^2 value of 0.42 indicates that 42% of the variation in student participation can be explained by internet access availability. In addition, the regression analysis also showed that internet speed is a significant predictor of student participation, where students with internet speeds of more than 10 Mbps showed higher participation compared to students with internet speeds between 1-10 Mbps or less than 1 Mbps (Halverson & Graham, 2019). Students with internet speeds between 1-10 Mbps showed lower participation, while students with internet speeds less than 1 Mbps showed the lowest participation in online learning. These results underline the importance of fast and stable internet access to support students' active engagement in online learning (Akmal *et al.*, 2022). Therefore, efforts to improve internet access and speed in underdeveloped areas are essential to support more inclusive and effective education (Wandira *et al.*, 2021).

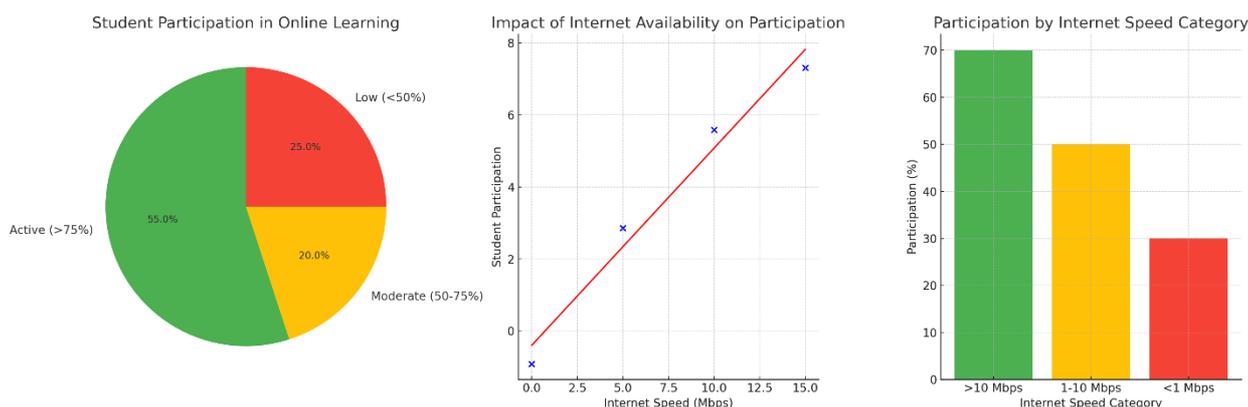


Figure 3. The effect of internet access availability on student participation in online learning.

Discussion

Availability of Internet Access in Aceh Province

The results of this study confirm that the availability of internet access in Aceh Province is still a major challenge, especially in rural and remote areas. Although there has been an increase in internet access in urban areas, many students in rural areas still experience limited internet access. Aceh's varied geographical conditions and limited infrastructure have led to disparities in the availability of internet services. A study by Syahputra (2021) also found that remote areas in Aceh are often not covered by adequate internet services, which has a negative impact on students' ability to participate in online learning. Limited internet access in rural areas makes it difficult for students



to access learning materials in real time, resulting in a lag in the teaching and learning process. Students in these areas often have to use public facilities such as internet cafes or places with free Wi-Fi access, which do not always allow for consistent and focused learning. This condition strengthens the findings of a study by Warschauer and Matuchniak (2010) which showed that limited internet access can hinder students' participation and academic achievement.

The Influence of Internet Access Availability on Student Participation

This study shows that the availability of good internet access significantly affects student participation in online learning. Students with fast and stable internet access are more active in attending virtual classes, working on assignments, and engaging in online discussions. This is in line with research by Kurniawan (2021) which found that students with good internet access showed better learning outcomes and higher participation in online learning. Adequate internet access allows students to easily access various educational resources and follow learning in real-time. This not only increases their involvement in the learning process but also increases their motivation and ability to learn independently. Students who have good internet access are also more likely to use various digital tools to learn, which can improve their understanding of the subject matter. Conversely, students who face limited internet access often face difficulties in attending virtual classes and submitting assignments on time. These limitations lead to low student participation and can have a negative impact on their learning outcomes. A study by Dewi (2020) showed that students who do not have stable internet access are more likely to show decreased motivation and engagement in online learning, which ultimately impacts their academic achievement.

Implications for Education in Aceh Province

The findings of this study have important implications for education in Aceh Province. First, the government and schools need to work together to improve internet access in underdeveloped areas. This can be done through improving telecommunications infrastructure, such as expanding fiber optic networks and increasing cellular network capacity in rural areas. Programs such as the Universal Service Obligation (USO) managed by the Ministry of Communication and Information Technology need to be expanded to cover more remote areas in Aceh. Second, there needs to be a support program for students with limited internet access, such as providing learning devices and free Wi-Fi access in schools or local communities. This program can help students stay engaged in online learning and reduce the digital divide among students from different economic backgrounds. Third, schools and teachers need to be more flexible in supporting students with limited internet access. This could include providing learning materials that can be accessed offline or providing more flexible deadlines for assignment submissions. A more inclusive and responsive approach to students' needs can help increase their participation in online learning.

Conclusion

From the analysis that has been obtained in this study, it can be concluded that the availability of internet access has a significant influence on the level of student participation in online learning in the province of Aceh. However, the study's results show that students with fast and stable internet access participate more than students with limited internet access. More specifically, the availability of good internet access increases student participation by 0.65 units for every one unit increase in availability of internet access, accounting for 42% of the variation in student participation ($R^2 = 0.42$, $p < 0.05$). Students with internet speeds greater than or equal to 10 Mbps had the highest participation in online learning. Students with internet speeds of less than 10 or 1 Mbps had high dropout rates in online learning. These results support that reliable and fast internet access is critical to facilitate active student participation in online learning. They also hinted that parental support and the infrastructure preparedness of the school might help student participation. Thus, the efforts to level out internet access and speed, particularly in rural and remote areas in Aceh Province, play pivotal roles in striving more inclusive and effective education. The telecom infrastructure isn't the only one to be improved, the government, schools and other stakeholders should work towards providing programs for students with limited access to the internet. This will contribute to the reduction of digital divide and the increase of education quality in Aceh Province.



References

- Akmal, M., Lubis, L., & Haris, A. (2022). Hubungan dukungan sosial dan self efficacy dengan keterlibatan siswa pada SMK swasta YPT Pangkalan Susu Kabupaten Langkat. *Jurnal Sains Sosio Humaniora*, 6(1), 1042-1066. <https://doi.org/10.22437/jsosh.v6i1.21649>
- Arwa, B. W., & Sejati, R. H. P. (2024). Rancang Bangun Aplikasi Augmented Reality Sebagai Pembelajaran Metamorfosis Kupu-Kupu. *Jurnal Indonesia : Manajemen Informatika Dan Komunikasi*, 5(2), 1649-1657. <https://doi.org/10.35870/jimik.v5i2.723>
- Aryanti, P. G., Rasiban, Sarimole, F. M., & Tundo. (2024). Pengembangan Media Pembelajaran Berbasis Teknologi Augmented Reality (AR) dengan Algoritma Vuforia SDK pada Mata Pelajaran IPA Kelas VIII di Madrasah Al-Aqsha (MTS). *Jurnal Indonesia : Manajemen Informatika Dan Komunikasi*, 5(3), 3004-3019. <https://doi.org/10.35870/jimik.v5i3.998>
- Clark, R. C., & Mayer, R. E. (2016). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning*. Wiley.
- Dewi, S. (2020). The impact of internet accessibility on students' online learning participation in rural areas. *Journal of Educational Technology*, 5(2), 45-56.
- Fajri Yasin, A., Rumakat, F., Way, D., & Jitmau, A. M. (2024). Program Pengadaan Tempat Sampah di Kelurahan Klawuyuk dan Sekolah Dasar Islam Terpadu Daarul Fikri Cendekia. *Jurnal Pengabdian Nasional (JPN) Indonesia*, 5(2), 552-558. <https://doi.org/10.35870/jpni.v5i2.894>
- Faroek, D. A., Tella, F., Ermin, Yusuf, M., Nurdjan, N., & Nurfitri. (2024). Sosialisasi Efek Negatif Perkembangan Teknologi pada Remaja di SMK YPK Imanuel Kota Sorong. *Jurnal Pengabdian Nasional (JPN) Indonesia*, 5(2), 443-448. <https://doi.org/10.35870/jpni.v5i2.828>
- Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education: Framework, principles, and guidelines*. Jossey-Bass.
- Halverson, L., & Graham, C. (2019). Learner engagement in blended learning environments: A conceptual framework. *Online Learning*, 23(2). <https://doi.org/10.24059/olj.v23i2.1481>
- Hidayat, R., Rohaya, A., Nadine, F., & Ramadhan, H. (2019). Challenges in implementing online learning in remote areas in Indonesia. *Indonesian Journal of Educational Research*, 4(1), 20-35.
- Ikhwan, M. K., Sufyan, & Syafrinal. (2024). Lembar Persempengembangan Game Edukasi Keterampilan Membaca Untuk Siswa Tk Islam Ceria Hidayatullah Menggunakan Program Visual Scratch. *Jurnal Ilmu Komputer Dan Teknologi Informasi*, 1(2), 36-50. <https://doi.org/10.35870/jikti.v1i2.1079>
- International Telecommunication Union. (2021). *Measuring digital development: Facts and figures*. <https://www.itu.int/>
- Irvan, M. F., Sari, E. F., Ahmadi, F., Nugrahani, A. G., & Zulfana, S. A. (2025). Peningkatan Pemahaman Guru Sekolah Indonesia Davao tentang Proyek Penguatan Profil Pelajar Pancasila Melalui Pendampingan Pembelajaran Terstruktur. *Jurnal Pengabdian Nasional (JPN) Indonesia*, 6(1), 252-261. <https://doi.org/10.35870/jpni.v6i1.1258>
- Iskandar, A. (2020). Internet for all: Impact of internet programs on education in rural Indonesia. *International Journal of Educational Development*, 70, 102132. <https://doi.org/10.1016/j.ijedudev.2020.102132>



- Kementerian Komunikasi dan Informatika. (2021). *Palapa Ring Project: Expanding internet connectivity across Indonesia*. <https://www.kominfo.go.id/>
- Kurniawan, D. (2021). The role of internet speed in enhancing student participation in online learning. *Journal of Digital Education*, 3(3), 12-25.
- Lestari, D., & Lestari, S. (2024). Penerapan Data Mining Klasifikasi Tingkat Pemahaman Siswa Pada Kegiatan Belajar Mengajar dengan Metode Decision Tree (Studi Kasus SDN Malaka Jaya 11 Duren Sawit). *Jurnal Indonesia : Manajemen Informatika Dan Komunikasi*, 5(2), 1260-1268. <https://doi.org/10.35870/jimik.v5i2.662>
- Nindito, D. (2020). Factors affecting student motivation and participation in online learning in Indonesia. *Indonesian Journal of Educational Technology*, 7(1), 34-50.
- Putra, P., Sari, L., Rahmat, A., & Zulfikar, T. (2019). Availability of internet access and its impact on student participation in online learning in Aceh. *Aceh Journal of Education*, 5(4), 55-65.
- Rasmitadila, R., Aliyyah, R., Rachmadtullah, R., Samsudin, A., Syaodih, E., Nurtanto, M., & Tambunan, A. (2020). The perceptions of primary school teachers of online learning during the COVID-19 pandemic period: A case study in Indonesia. *Journal of Ethnic and Cultural Studies*, 7(2), 90-109. <https://doi.org/10.29333/ejecs/388>
- Safii, R., & Ritonga, H. J. (2024). Strategi Pimpinan dalam Meningkatkan Efektivitas Pembelajaran Tilawatil Qur'an di Rumah Qur'an Umi Kartini Medan. *Jurnal Indonesia : Manajemen Informatika Dan Komunikasi*, 5(2), 2050-2058. <https://doi.org/10.35870/jimik.v5i2.841>
- Sartono, R. R., & Fachri, M. (2024). Aplikasi Mobile Digital Library SMP N 1 Kaliiori Kabupaten Rembang. *Jurnal Indonesia : Manajemen Informatika Dan Komunikasi*, 5(2), 1858-1866. <https://doi.org/10.35870/jimik.v5i2.762>
- Satria, F., & Waluyo, A. F. (2024). Aplikasi Pengenalan Senjata Tradisional Yogyakarta Berbasis Augmented reality. *Jurnal Indonesia : Manajemen Informatika Dan Komunikasi*, 5(2), 1111-1120. <https://doi.org/10.35870/jimik.v5i2.588>
- Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2014). What drives a successful e-learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education*, 50(4), 1183-1202. <https://doi.org/10.1016/j.compedu.2013.07.084>
- Syahputra, I. (2021). Internet accessibility in remote areas: A case study of Aceh Province. *Journal of Telecommunications Policy*, 45(2), 102034. <https://doi.org/10.1016/j.telpol.2020.102034>
- Tella, F., Jundullah, M., Murni, Nurdjan, N., Hasa, M. F., & Ghirdaly. (2025). Pengenalan Game Edukasi Flora dan Fauna untuk Siswa SD Inpres 4 Arborek Raja Ampat. *Jurnal Pengabdian Nasional (JPN) Indonesia*, 6(1), 301-310. <https://doi.org/10.35870/jpni.v6i1.1305>
- Triase, Manurung, L. A., & Atsil, R. A. (2024). Aplikasi Survei Kepuasan Peserta Diklat Berbasis Mobile Untuk Meningkatkan Pelayanan Diklat. *Jurnal Indonesia : Manajemen Informatika Dan Komunikasi*, 5(2), 1320-1331. <https://doi.org/10.35870/jimik.v5i2.670>
- UNESCO. (2020). *Global education monitoring report 2020: Inclusion and education: All means all*. UNESCO.
- Wandira, P., Sabrina, M., Sinaga, N., Putri, J., & Nasution, T. (2021). Dampak pembelajaran daring pada siswa dan guru di era COVID-19. *Jurnal Citizenship Virtues*, 1(2), 151-156. <https://doi.org/10.37640/jcv.v1i2.1006>



Wardhono, A., Qori'ah, C. G., Nasir, M. A., Ubaidillah, M., Rafa, M., Sultonia, I., Arinanta, A., Fauziah, R., Fatmawati, Y., Puspito, A. N., & Prakoso, B. (2024). Pengembangan Kreativitas Anak Sekolah Dasar melalui Program Seni dan Kerajinan Tangan di MI Miftahul Ulum. *Jurnal Pengabdian Nasional (JPN) Indonesia*, 5(3), 619-629. <https://doi.org/10.35870/jpni.v5i3.1035>

Warschauer, M., & Matuchniak, T. (2010). New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. *Review of Research in Education*, 34(1), 179-225. <https://doi.org/10.3102/0091732X09349791>