The Challenge in Implementation M-Learning on Post-Pandemic COVID-19 in North Sulawesi

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ABSTRACT

The COVID-19 pandemic has forced educational institutions to adapt to new ways of teaching and learning. Mobile learning (m-learning) has emerged as a promising solution to ensure continuous learning amidst a pandemic. However, the implementation of m-learning in North Sulawesi, Indonesia, is experiencing challenges due to various factors, such as limited access to technology and internet connectivity, inadequate digital literacy among teachers and students, and lack of support from the government. This article highlights the challenges and obstacles to implementing m-learning in North Sulawesi and provides recommendations to overcome these challenges. This research found that efforts should be made to improve internet connectivity, increase digital literacy among teachers and students, and provide support and resources to facilitate the implementation of m-learning. The results of this study also show that it is essential to issue government policies that support the integration of m-learning in the education system, especially in the post-pandemic era. This research concludes that the factors that pose a challenge to the implementation of m-learning need to be addressed segmentally according to the context and conditions of human resources, information technology infrastructure, and local government policies.

Keywords: Information Technology, M-Learning, North Sulawesi, Post-Pandemic Covid-19, University.

1. INTRODUCTION

The COVID-19 pandemic has had a significant impact on the world, including the education sector. School and university closures have forced educators to quickly adapt to online and remote learning. In this context, mobile learning (m-learning) has emerged as an alternative way to deliver educational content via mobile devices[1]. However, implementing m-learning on a large scale during the pandemic poses a number of challenges, especially in areas with limited infrastructure and limited access to technology. This research is focused on the implementation of m-learning in the post-pandemic era in North Sulawesi, Indonesia. The region faces unique challenges in implementing m-learning, including limited access to technology and internet connectivity.

The implementation of m-learning on a large scale during the COVID-19 pandemic has created a number of problems, especially in areas with limited access to technology and the Internet. In North Sulawesi, for example, internet access is still limited in some areas, which makes it difficult for students and educators to access online learning platforms[2]. In addition, not all students have sufficient mobile devices or computers to access online learning content. This can lead to an educational gap between students who have access to technology and students who do not have access to technology. In addition to the problem of access to technology, the implementation of m-learning also requires adequate technological skills from students and educators. Not all educators have sufficient technological skills to teach online, and not all students have sufficient technological skills to take part in online learning [3]. In addition, aspects of the interaction between students and educators in m-learning learning also need to be considered. In online learning, the interaction between students and educators can be reduced, which can affect the quality of learning.

Several previous studies have identified and explored solutions to overcome challenges in implementing m-learning during the COVID-19 pandemic. Several solutions have been tried and proposed such as technology training and assistance for educators and students. Technology training can help educators and students to develop the technology skills needed to access and use online learning platforms more effectively [4].

Apart from that, the solutions that have been made also include Providing better internet access. The government and educational institutions can try to expand the reach of the Internet in areas where access is still limited [5]. In addition, hotspots can be placed in several strategic places so that students with mobile devices can access online learning platforms more easily. Another solution is to use an accessible learning platform. Choosing an online learning platform that is easily accessible and easy to use by students and educators can help reduce difficulties in accessing and using the platform [6]. The next solution is to increase interaction between students and educators. The interaction between students and educators in m-learning can be increased by expanding the use of video conferencing and online discussion forums [7]. Apart from that, solutions such as developing interesting learning content according to student needs. Effective online learning requires learning content that is interesting and according to the needs of students [8]. Therefore, educators and educational institutions can develop learning content that is more interactive and based on student learning experiences. These solutions have been tried and proposed in several previous studies. However, in the context of implementing m-learning in North Sulawesi, more in-depth research is still needed to identify more appropriate and effective solutions to overcome the challenges faced.

This research has novelty in several aspects. First, this research focuses on challenges in implementing m-learning in North Sulawesi during the COVID-19 pandemic. North Sulawesi is an area that still has limited access to technology and the internet, so this research has great importance and relevance for solving the problems faced in the region. Second, this research identifies specific challenges and problems faced in North Sulawesi, which may be different from the challenges faced in other regions. Thus, this research can provide deeper and contextual insights into the challenges of implementing m-learning in the region. Third, this research tries to find appropriate and effective solutions to overcome the challenges faced. These solutions can help improve and enhance the implementation of m-learning in North Sulawesi and other parts of Indonesia. Fourth, this research is expected to contribute to the development of education policies in Indonesia regarding the implementation of m-learning in the future. During the COVID-19 pandemic, the use of technology in learning has become increasingly important and it is hoped that its effectiveness will continue to increase in the future. Therefore, the novelty of this research lies in focusing on the challenges of implementing m-learning in North Sulawesi, identifying specific problems and appropriate and effective solutions, as well as their contribution to the development of education policy in Indonesia.

Therefore, this research will explore the challenges in implementing m-learning in North Sulawesi and find the right strategy to overcome these problems. This research is expected to provide useful information for educators, students, and educational policies related to the application of learning technology in the future. This study aims to explore the challenges faced by educators and students in implementing m-learning in North Sulawesi and identify potential strategies to overcome these challenges. The findings from this research can be used to inform policy and practice regarding m-learning in the region and contribute to the broader discussion of educational technology in the post-pandemic era.

2. METHOD

The research method that will be used in this study is a case study with a qualitative approach. The research will be conducted in the North Sulawesi region by taking a sample of several schools that have implemented m-learning during the COVID-19 pandemic.

Data will be collected through interviews with several stakeholders, such as teachers, students, and parents. In addition, data collection will also be carried out through direct observation of the implementation of m-learning in class and analysis of documents related to the implementation of m-learning in the region.

The collected data will then be analyzed using qualitative data analysis techniques, such as content analysis and thematic analysis. This data analysis aims to identify challenges in the implementation of m-learning in North Sulawesi and find appropriate and effective solutions to overcome them.

Using the case study method and qualitative approach, this research is expected to provide a more in-depth and contextual description of the challenges of implementing m-learning in North Sulawesi and the solutions that can be taken to overcome them [9]. In addition, the use of a qualitative approach can also provide insight into the experiences and views of stakeholders regarding the implementation of m-learning in the region.

3. RESULTS AND DISCUSSION

3.1. Limited Access to Technology and The Internet

The results of the study show that the implementation of m-learning in the North Sulawesi region faces various challenges, especially related to limited access to technology and the internet. In the implementation of m-learning in North Sulawesi, there is limited access to technology and the internet which are the main obstacles. Some of these limitations include:

3.1.1. Internet Infrastructure

The North Sulawesi region still has limitations in internet infrastructure which includes coverage and speed. Some rural or remote areas may have limited or no internet access. This hinders students and educators from accessing and using online learning platforms. Internet infrastructure in North Sulawesi has challenges that need to be overcome in implementing m-learning. Some things to note regarding internet infrastructure in this region include:

1)	Internet coverage

North Sulawesi still has remote or rural areas that are difficult to reach by internet networks. This causes some students and educators to experience difficulties in accessing online learning content. Efforts are needed to expand internet coverage so that all regions of North Sulawesi can be connected properly[10].

2)	Internet Speed

Slow internet speed can hamper the smooth running of online learning. In the implementation of m-learning, adequate internet speed is needed to load and access learning materials efficiently. Increasing internet speed in North Sulawesi will greatly support the effectiveness of m-learning.

3)	Network Stability

Network interruptions frequently occur in areas of North Sulawesi, especially during bad weather or natural disasters. Low network stability can interfere with the smooth running of online learning and interactions between students and educators. It is necessary to improve and repair the network so that it can operate properly and stably.

4)	Price Accessibility

Apart from coverage and speed, the accessibility of internet prices is also an important consideration. Affordable internet package prices can encourage students and educators to use it in online learning [11]. Steps are needed to make internet services more affordable for the people of North Sulawesi.

To overcome these Internet infrastructure challenges, cooperation between governments, internet service providers, and educational institutions is essential. Efforts to repair and improve internet infrastructure, including extending coverage, increasing speed, and ensuring network stability, must be a priority in order to support the effective implementation of m-learning in North Sulawesi.

3.1.2. Equipment Availability

Not all students and educators in North Sulawesi have access to sufficient mobile devices or computers to access online learning content. This limitation affects students' ability to take part in online learning, as well as the ability of educators to deliver learning material through m-learning. The availability of IT equipment in North Sulawesi is an important factor in the implementation of m-learning. However, there are still a number of challenges related to this that need attention, including:

1)	Device Access Restrictions

Not all students and educators in North Sulawesi have access to adequate IT tools. Some students may only have limited access or even no devices such as laptops, tablets, or smartphones. These limitations can hinder students' ability to take part in online learning through m-learning.

2)	Limited Device Conditions

Some students who have IT equipment may use devices that are outdated or have low specifications. This can affect the performance and experience of using m-learning. Adequate device updates or replacements are needed so that students can access online learning content properly [12].

3)	Technology Knowledge and Skills

Not all students and educators in North Sulawesi have adequate technological knowledge and skills to operate IT devices and use them in learning. Low levels of digital literacy can be an obstacle in implementing m-learning. The necessary technology training and assistance so that students and educators can use IT tools effectively.

4)	Device Care and Maintenance

The availability of IT devices also needs to be accompanied by good care and maintenance. Damaged or malfunctioning devices can hinder students' and educators' ability to use them in online learning. Adequate policies and resources are needed to ensure regular care and maintenance of the device.

In order to overcome this challenge, the steps that can be taken include:

1)	Equipment Subsidy Program

The government and educational institutions can initiate IT device subsidy programs for students and educators who need them. This program can help increase the availability of devices in North Sulawesi.

2)	Cooperation with Private Parties

Partnerships with private parties, such as technology companies or telecommunication service providers, can facilitate the provision of IT equipment at affordable prices or special offers for students and educators.

3)	Technology Training Program

Technology training and mentoring programs can be organized to increase students' and educators' digital literacy. This training may cover device operation, use of

m-learning applications and platforms, and utilization of online resources.

4) Collection and Distribution of Used Equipment

Collection of used devices from individuals or organizations can be carried out and then distributed to students in need

3.1.3. Quality of Internet Connection

Although internet access is available, the quality of the internet connection in North Sulawesi is often inconsistent. Network interruptions and slow internet speeds can hamper the smooth running of online learning and interactions between students and educators. The quality of the internet connection in North Sulawesi is an important factor in the implementation of m-learning. However, there are several challenges related to internet connection quality that need attention, including:

1) Slow Connection

One of the main challenges is the slow internet connection speed. Low speed can result in long loading times for online learning content, prolonged buffering, and intermittent interactions. This can disrupt the smooth learning and experience of students and educators in using m-learning.

2) Network Interference

Internet network disruptions often occur in several areas in North Sulawesi. Factors such as bad weather, natural disasters, or technical problems can cause the network to become disconnected or unstable. Disruptions of this kind can disrupt the continuity of online learning and interactions between students and educators[13].

3) Limited Capacity

Limited internet infrastructure in terms of capacity is also a challenge. If many students and educators use the internet connection at the same time, this can cause excessive load on the network and result in decreased connection quality.

4) Restricted Access on 4G or 5G Network

Some areas in North Sulawesi may still have limited access to a faster and more stable 4G or 5G network. This limitation can affect the experience of students and educators in using m-learning which requires high connection speeds.

To overcome this challenge, several steps that can be taken are:

1) Infrastructure Improvement

It is necessary to invest in improving internet infrastructure in North Sulawesi, including installing better network infrastructure and updating technology to increase the speed and stability of internet connections[14].

2) Improved Access to 4G or 5G Networks

Efforts need to be made to expand the coverage of 4G or 5G networks throughout the North Sulawesi region. This will improve the quality of internet connection and support more effective use of m-learning.

3) Network Traffic Management

Internet service providers and governments need to implement effective network traffic management to avoid overcharging. By optimizing network capacity, connection quality can be improved and maintained.

4) Awareness Raising

It is necessary to increase awareness of the importance of internet connection quality in m-learning. Students, educators, and parents need to be made aware of how the quality of good connections can affect online learning.

3.1.4. Digital Literacy Level

The level of digital literacy among students and educators can also be an obstacle in implementing m-learning. Some students may not be familiar with or have sufficient technological skills to operate online learning platforms, whereas some educators may not be adequately trained in using technology for learning. The level of digital literacy in North Sulawesi is an important factor in the implementation of m-learning[15]. A high level of digital literacy will support the effectiveness of using technology in online learning. However, there are still challenges related to digital literacy that need attention, including:

1) Technology Knowledge and Skills

The level of digital literacy in North Sulawesi may still be low among students and educators. Some of them may not be familiar with or do not have sufficient technological knowledge and skills to use IT tools, operate online learning platforms, and utilize digital resources in learning.

2) Awareness of Digital Security

Lack of awareness about digital security is also a challenge in implementing m-learning. Students and educators need to understand the importance of protecting their privacy, avoiding online scams, and practicing safe habits when using technology. A lack of digital literacy can make them vulnerable to digital security risks.

3) Access to Digital Resources

The level of digital literacy can also be affected by the availability of access to quality digital resources.

Students and educators may face limitations in accessing online learning materials, e-learning platforms, or other digital resources. This limited access can affect their ability to develop adequate digital literacy.

To overcome the challenges of digital literacy, several steps that can be taken are:

1) Digital Literacy Training Program

It is necessary to carry out a digital literacy training program for students, educators, and the general public in North Sulawesi. This training can cover the use of IT tools, online navigation, understanding digital security, and the use of online learning platforms. The training can be carried out in collaboration with educational institutions, the government, and non-governmental organizations.

2) Increased Access to Digital Resources

Efforts need to be made to increase student and educator access to quality digital resources. Governments and educational institutions can play a role in providing affordable internet access and providing the necessary technological support, such as adequate IT equipment and connectivity.

3) Provision of Digital Learning Materials that are Easy to Understand

Digital learning materials must be prepared in clear and easy-to-understand language. A user-friendly and intuitive approach can help students and educators who have low levels of digital literacy adapt more easily to online learning technologies [16].

4) Partnership with the Technology Industry

Partnerships with the technology industry can provide access to relevant resources and experience. Technology companies can play a role in providing training, learning content

3.1.5. Power Limitations

North Sulawesi also faces limitations in stable electricity supply, especially in rural areas. This can interfere with the smooth use of technology devices and limit online learning time. The availability of sufficient electrical resources is an important factor in the implementation of m-learning in North Sulawesi. The use of IT devices for online learning requires a stable and reliable power supply. However, there are several challenges related to the availability of electricity resources that need attention, including:

1) Limited Electrical Infrastructure

Some areas in North Sulawesi may still face limited electricity infrastructure. Frequent power outages or unstable power grids can disrupt the smooth running of

online learning. This condition can cause disruptions in the access and participation of students and educators in m-learning.

2) Access to Electricity in Remote Areas

Some remote areas in North Sulawesi may not be reached by adequate electricity supply. This can make it difficult for students and educators to use IT tools and access online learning. This limited access to electricity is an obstacle to implementing effective m-learning.

3) Instability of Power Supply

Power supply instability, such as voltage fluctuations or frequent power outages, can damage IT equipment and hinder online learning. This condition can have a negative impact on the smoothness of learning and the continued use of m-learning.

To overcome the challenges of the availability of electricity resources, several steps that can be taken are:

1) Expansion of Electrical Infrastructure

The government and power companies need to invest in expanding electricity infrastructure throughout North Sulawesi. These efforts include upgrading the power grid, building substations, and installing wider electrical connections. Thus, previously unreachable areas can have better access to electricity.

2) Utilization of Renewable Energy

The utilization of renewable energy sources, such as solar or hydroelectric energy, can be an alternative to providing a stable supply of electricity in hard-to-reach areas. The government can encourage the development and implementation of renewable energy solutions to overcome the limitations of electricity infrastructure.

3) Use of Reserved Resources

Providing a backup power source, such as a generator or battery, can help deal with unexpected power outages. Schools and educational institutions may consider using backup resources to keep online learning smooth in the event of a power outage.

4) Planning and Coordination

The government and related institutions need to carry out proper planning and coordination in overcoming the availability of electricity resources. Steps such as electricity network maintenance schedules, and others.

These limitations are the main factors affecting the implementation of m-learning in North Sulawesi. In addressing this challenge, collaborative efforts are needed between the government, educational institutions, and other stakeholders to improve internet infrastructure, expand device access, increase digital literacy, and ensure a stable electricity supply in the region.

3.2. Learning Content Development

Several schools that have implemented m-learning have also experienced problems in developing learning content that suits students' needs. The development of quality and relevant learning content is very important in the implementation of m-learning in North Sulawesi. Good learning content will ensure students get an effective and meaningful learning experience through online learning platforms. The following are several aspects that need to be considered in developing learning content:

3.2.1. Relevant curriculum

Learning content must be based on a curriculum that is relevant to education standards in North Sulawesi. The content must include subject matter that is appropriate to the intended level of education and meets the stated curriculum needs. Relevant curriculum development is an important component in the implementation of m-learning in North Sulawesi. The right curriculum will ensure that learning materials delivered through online learning platforms match the needs of students and include relevant competencies [17]. Here are some things that need to be considered in the development of a relevant curriculum:

1) National Curriculum Standards

Curriculum development in North Sulawesi must be based on the National Curriculum Standards (SKN) that have been set by the government. SKN describes the basic competencies that must be achieved by students at each level of education. The curriculum in North Sulawesi needs to ensure that the learning materials delivered through m-learning are in accordance with the SKN. In North Sulawesi, several schools have started using the independent curriculum.

2) Local Needs

The relevant curriculum must take into account local needs in North Sulawesi. It covers the cultural context, environment, and specific challenges faced by students in the area. Curriculum development should reflect the uniqueness of North Sulawesi and enable students to develop a deep understanding of local conditions and the relevant skills to deal with them.

3) Competence of 21st Century Skills

The curriculum in North Sulawesi must also pay attention to the development of 21st Century Skills competencies. This competency includes skills such as technology skills, problem-solving, collaboration, creativity, and digital literacy. M-learning can be used as a means to develop and test these competencies through innovative and technology-based learning approaches [18].

4) Technology Integration in Curriculum

The relevant curriculum in North Sulawesi must integrate technology effectively. This includes the use of online learning platforms, mobile applications, or other digital resources in the delivery of learning materials. The curriculum must design learning activities that utilize technology in ways that enrich students' learning experiences.

5) Project-Based Learning

The relevant curriculum can adopt a project-based learning approach. This approach allows students to learn through real projects that are relevant to the North Sulawesi context. Through these projects, students can develop their critical thinking skills, collaboration skills, and creativity.

6) Evaluation and Monitoring

The relevant curriculum in North Sulawesi must include an effective evaluation and monitoring mechanism. Evaluations should include formative and summative assessments that allow educators to track student progress and provide constructive feedback. Monitoring is also important to ensure that the curriculum continues to run well.

3.2.2. Diversification of Learning Materials

Learning content needs to be diversified to accommodate different learning styles and student needs. Learning materials can be presented in a variety of formats, including text, images, video, audio, or other interactive resources. This diversification can increase student interest and involvement in the learning process. Diversification of learning materials is an important aspect of implementing m-learning in North Sulawesi. This approach aims to accommodate a variety of student learning styles and increase their interest and involvement in the online learning process. Here are some things to consider in diversifying learning materials:

1) Multiple Content Formats

Learning materials can be presented in various formats, such as text, images, video, audio, infographics, or other interactive resources. The use of multiple formats will allow students to learn in a way that best suits their preferences and learning styles.

2) Relevant and Contextual Learning Materials

Learning materials need to be relevant to the daily lives of students in North Sulawesi. This can include cultural context, environment, and relevant local issues.

Contextual content will help students make stronger connections between learning concepts and their own experiences.

3) Use of Multimedia

The use of multimedia, such as video, audio, or animation, can make learning materials more interesting and interactive. Multimedia content can enrich students' learning experiences and help them understand concepts better.

4) Virtual Simulation and Demonstration

In m-learning, virtual simulations and demonstrations can be effective tools for illustrating abstract concepts or complex processes. Through simulations or virtual demonstrations, students can directly interact with the concept, increasing their understanding.

5) Adaptive Content

Learning content can be designed to be adaptive, according to the level of understanding of students. By utilizing adaptive technology, learning materials can be adjusted to the level of difficulty according to students' abilities. This allows each student to study at their own pace.

6) Online Collaboration and Discussion

Diversification of learning materials also includes the use of collaborative activities and online discussions. This can involve students in virtual group work, discussion forums, or other interactive platforms. Through collaboration and discussion, students can exchange ideas, broaden their horizons, and increase their understanding.

By diversifying learning materials, the implementation of m-learning in North Sulawesi can be more effective and attractive to students. This approach allows each student to learn in a way that suits their preferences, thereby increasing engagement and overall learning outcomes.

3.2.3. Interactive and Engaging

Learning content must be designed interactively to encourage active student participation. The use of interactive elements, such as interactive questions, exercises, or simulations, can help students become actively involved in learning. Interactive content will improve understanding and retention of information. An interactive learning approach that involves students is very important in the implementation of m-learning in North Sulawesi. This aims to increase student involvement in the online learning process and strengthen their understanding of the material presented. Here are some aspects to consider in creating an interactive and engaging learning experience:

1) Interactive Activities

M-learning must provide a variety of interactive activities that allow students to be actively involved in learning. Activities such as interactive quizzes, learning games, interactive exercises, or virtual simulations can be used to encourage student participation and activate their learning process.

2) Online Discussion

Encouraging online discussion on m-learning platforms is an effective way to engage students in critical thinking, problem-solving, and exchange of ideas. Online discussions can allow students to share opinions, ask questions, and give each other feedback, thereby enriching their understanding and perspectives.

3) Collaboration and Virtual Group Work

Through m-learning, students can collaborate and work in virtual groups. They can work together on online projects, group assignments, or activities that require collaboration. This will enhance students' collaboration, communication, and leadership skills.

4) Real-time Feedback and Evaluation

The m-learning system can provide real-time feedback and evaluation to students. Feedback given immediately after students complete an assignment or exercise can help them understand their strengths and weaknesses. This allows students to directly improve their understanding and improve their performance.

5) Visual and Audio Engagement

The use of attractive visual and audio elements in m-learning learning materials will help increase student engagement. Short videos, animations, engaging images, or clear audio can enrich students' learning experiences and make the material easier to understand and remember.

6) Giving Challenges and Projects

M-learning can provide challenges and projects that require students' creative thinking and problem-solving. These challenges and projects will motivate students to apply the concepts they learn in real-world situations, strengthening their understanding and developing practical skills.

Through an interactive approach and involving students in the learning process, the implementation of m-learning in North Sulawesi can create interesting, meaningful, and effective learning experiences. Students will be actively involved in learning, strengthen their understanding, and develop their abilities.

3.2.4. Adjustment to Local Conditions

Learning content needs to be adapted to local conditions in North Sulawesi. This includes using examples and situations that are relevant to the culture, environment, or social context of the local community. This adjustment will make learning content more meaningful and contextual for students. Adaptation to local conditions in North Sulawesi is an important factor in the implementation of m-learning. This adjustment will ensure that the online learning platform and learning materials presented are relevant to the needs and context of students in North Sulawesi. The following are some aspects that need to be considered in adapting to local conditions:

1) Cultural Context and Traditions

North Sulawesi has a rich diversity of cultures and traditions. In the implementation of m-learning, learning content must accommodate and respect this diversity. Learning materials can include elements of local culture, traditional stories, or examples that are relevant to the cultural context and traditions in North Sulawesi. This will help students feel connected to the learning material and increase their understanding.

2) Local Issues and Specific Needs

Adjustment to local conditions also includes an understanding of local issues currently being faced by the people of North Sulawesi. For example, environmental issues, nature conservation, or social issues that are specific to that area. Learning materials can present these issues in a relevant way and give students insight into how they can contribute to solving these local problems.

3) Local Language

The use of local languages in learning materials can be an important factor in adapting to local conditions. Using local languages that students understand can strengthen their understanding and involvement in the learning process. In addition, this can also help maintain and strengthen the cultural identity of students in North Sulawesi.

4) Local Case Studies

Presenting relevant local case studies can help students relate learning concepts to the real context in North Sulawesi. Engaging students in local case study analysis, data collection, or local problem-based problem-solving will help them develop practical skills that can be applied in everyday life.

5) Availability of Local Resources

Implementation of m-learning must consider the availability of local resources in North Sulawesi. This includes internet accessibility, technology devices, or infrastructure that supports online learning. Adjustment to local conditions also includes identifying and overcoming obstacles that may arise due to limited resources.

By adjusting to local conditions in North Sulawesi, the implementation of m-learning can become more relevant, effective, and meaningful for students. This customization will allow students to feel connected to the learning material, increase their engagement, and increase the understanding and practical skills required.

3.2.5. Good Visual and Audio Quality

Learning content must have good visual and audio quality. Vivid visuals, attractive images, and clear audio will help students better understand and follow the learning material. The use of quality media can also increase students' interest in learning. Good visual and audio quality is an important factor in the implementation of m-learning in North Sulawesi. Good quality will ensure students can get an effective, interesting, and comfortable learning experience. Here are some things that need to be considered regarding visual and audio quality in the implementation of m-learning:

1) High-Quality Videos

Video is an important component in m-learning. Make sure the video used is of high quality, clear resolution, and looks good. Clear videos will help students see clearly the details and content being conveyed. If possible, choose videos with subtitles or subtitles that can help students understand the content better.

2) Clear Sound

Clear and quality audio is an important aspect of m-learning. Make sure the voice used in learning materials is easy to hear and well-heard. Avoid sound that is distorted or too low in volume. Ensuring a clear voice will help students hear well and understand instructions or explanations given.

3) Use of Attractive Graphics and Animation

Attractive graphics and animations can enrich students' visual experiences in m-learning. Use relevant graphics, eye-catching illustrations, or animations to help visualize abstract concepts. This will help students understand and remember learning material better.

4) Compatibility with Devices

Ensure m-learning learning materials are compatible with the various types of devices used by students in North Sulawesi. This includes compatibility with commonly used mobile devices, tablets, or computers. Ensuring visual and audio quality is maintained across a

variety of devices will give students flexibility and accessibility.

5) Use of Accessible Multimedia

M-learning learning materials should use multimedia that can be accessed by students in North Sulawesi. Taking into account the limitations of internet accessibility and connection speed in the area will help to choose the appropriate file format and size. Make sure multimedia files can be downloaded or played smoothly without overloading the student's internet connection.

By ensuring good visual and audio quality in the implementation of m-learning in North Sulawesi, students will be able to experience a more interesting and interactive learning experience. Good quality will help students understand better, increase their engagement, and get the most out of online learning.

3.2.6. Appropriate use of technology

The development of learning content must also consider the use of appropriate technology. The online learning platform, mobile application, or learning software used must suit the needs of students and allow for easy interaction between students and educators. The use of the right technology is a crucial factor in the implementation of m-learning in North Sulawesi. The selection of the appropriate technology will ensure the effectiveness and efficiency of online learning. Here are some things that need to be considered regarding the use of appropriate technology in the implementation of m-learning:

1) Accessibility and Compatibility

Ensure that the technology used in m-learning is easily accessible to students in North Sulawesi. Learning software or applications must be compatible with the various types of devices that are commonly used, such as mobile devices, tablets, or computers. In addition, ensure compatibility with various popular operating systems.

2) Stable Internet Connection

A stable internet connection is an important prerequisite for implementing m-learning. North Sulawesi has challenges in terms of internet infrastructure, so it is important to ensure the availability of a reliable connection for students. Choose an m-learning platform that can work well under connection conditions that may vary. In addition, consider offline access options for students who may have limited internet access.

3) User-Friendly Learning Platform

Choose an online learning platform that is easy to use and has an intuitive interface for students in North Sulawesi. The platform should provide clear navigation,

an organized layout, and easy-to-understand features. This will help students make the most of technology smoothly and reduce any technical barriers that may arise.

4) Appropriate Use of Applications and Software

Identify and select applications and software that suit the learning needs of m-learning in North Sulawesi. Make sure that the application has relevant features and can support interaction and collaboration between students and teachers. Evaluation of applications based on reliability, security, and availability of technical support is also important in choosing the right technology.

5) Data Security

It is important to keep student data secure when using technology in m-learning implementations. Ensure that the platforms and applications used comply with the necessary security standards to protect personal information and student data. Also consider providing students, teachers, and parents with an understanding of data protection.

Using by the right technology, the implementation of m-learning in North Sulawesi can be more effective, efficient and easily accessible to students. Selection of the right technology will help improve the learning experience of students, facilitate collaboration, and support the creation of an innovative and interactive learning environment.

The development of good learning content requires collaboration between educators, curriculum experts, multimedia designers, and technology developers. Through good cooperation, quality and relevant learning content can be developed to support the implementation of m-learning in North Sulawesi.

In addition, the research results also show that stakeholders, such as teachers and students, need deeper training and support in implementing m-learning effectively. Parents of students also need clearer information about the benefits and risks of using m-learning in learning.

To overcome these challenges, this study recommends several solutions, such as:

1) Provision of adequate technology and internet infrastructure in the North Sulawesi region

2) Development of learning content that is more in line with the needs and conditions of students in the region

3) More intensive training and support for teachers in implementing m-learning effectively

4) Provision of clearer and transparent information about the benefits and risks of using m-learning for parents of students

In addition, this research also contributes to the development of education policy in Indonesia, especially related to the use of technology in learning. This research demonstrates the importance of developing appropriate policies and effective implementation to improve and enhance future learning.

4. CONCLUSION

This study concludes that the importance of an This study concludes that the implementation of m-learning in the North Sulawesi region faces significant challenges, especially related to limited access to technology and the Internet. Recommended solutions to address these challenges include providing adequate technology infrastructure, developing learning content that is more suited to student needs, more intensive training and support for teachers, and providing clearer information for parents of students. This research also demonstrates that effective policy development and implementation are critical to improving and enhancing future learning. Therefore, the solution recommendations from this research can be a reference for the government and educational institutions in developing policies and strategies for implementing more effective m-learning in the future. This research is expected to make a positive contribution to the development of education in Indonesia, especially in facing the challenges of learning in the era of the COVID-19 pandemic and an increasingly digital future.

AUTHORS' CONTRIBUTIONS

Djubir R. E. Kembuan, acting as the lead researcher with the main task of coordinating and carrying out research activities in the process of data collection, data collection, data analysis, preparation of data interpretation, and preparation of research reports. In addition, he is tasked with coordinating and implementing activities research in the preparation of research instruments, research equipment, and supporting instruments. then tasked with coordinating and carrying out research activities in research development such as concept formulation, system research instrument validation, and conducting final evaluations. In addition, the chairman is tasked with coordinating and carrying out research activities in preparing the final research report, and publication of research results in national seminars/proceedings. Another task is Coordinating and being responsible for results research reporting ranging from daily reports, reports progress, final report, and use of research budget.

Johan Reimon Batmetan, as a research member, is tasked with 1. Assisting the chairman in the process of

data collection, data collection, data analysis, preparation of data interpretation, and preparation of research reports. 2. Assist the chairman in preparing research instruments, research equipment, and supporting instruments. 3. Assisting the Chair in system development: formulating concepts, functions, conducting system assembly, system validation, system testing both laboratory scale, partners and broad stakeholder scale, final system evaluation 4. Assisting the chairman in preparing the final research report, and publication of research results in national seminars/proceedings. 5. Also responsible for the results of research reporting starting from daily reports, progress reports, final reports, and the use of research budgets.

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