



Needs Analysis of Learning Media Development Based on Markerless Augmented Reality in Learning Computer Networking

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Abstract. The One of the strategic agendas stated in the Ministry of Education and Culture's Strategic Plan is to improve the quality of national education. Various comprehensive efforts have been made and will continue to be implemented to achieve this goal, including the provision of adequate learning facilities and resources. Based on observations during the learning process of Computer networking material, it was found that the utilization of ICT in learning activities was still not optimal. The research method used in this study is a quantitative descriptive method with a survey approach, which aims to describe existing phenomena or conditions in a systematic and measurable manner. This research was conducted in the Program Studi Pendidikan Teknologi Informatika dan Komputer environment of Universitas Negeri Medan, focusing on students of class 2021. Based on the data analysis that has been done, several conclusions can be drawn as follows: (1) Of the total 119 respondents, 117 students (98.3%) have Android-based smartphones, while only 2 students (1.7%) do not have such devices. This shows the readiness of most students in adopting Android-based technology to support digital-based learning. (2) All respondents, namely 100% of students, agreed with the implementation of Android-based learning media for the Computer Networking subject. The main reason for this agreement is the ability of Android media to display 2-dimensional and 3-dimensional visualizations that help understanding concepts, which were identified by 23.1% of respondents.

Keyword: Needs analysis, Learning media, Markerless augmented reality, Computer networking.

1 Introduction

The One of the strategic agendas stated in the Ministry of Education and Culture's Strategic Plan is to improve the quality of national education. Various comprehensive efforts have been made and will continue to be implemented to achieve this goal, including the provision of adequate learning facilities and resources. Along with the rapid development of science and technology, especially in the field of communication and information technology (ICT), learning media has now become an inevitable need. However, the utilization of this media in educational institutions, especially at the campus level, is often still limited to administrative functions, not yet optimal in

supporting the learning process. This indicates a big challenge that needs to be overcome to improve the overall quality of education.

The learning process is a key element in achieving educational goals. Learning can be declared effective if students succeed in achieving a comprehensive understanding of the concepts presented by the instructor. At Universitas Negeri Medan, especially in the Program Studi Pendidikan Teknologi Informatika dan Komputer (PTIK), one of the subjects that plays an important role is Computer networking. The focus in this subject is the introduction and understanding of various aspects of network infrastructure, including related hardware and software. Students are encouraged to be able to analyze each component of a computer networking and understand the steps in solving network problems systematically and precisely.

Based on observations during the learning process of Computer networking material, it was found that the utilization of ICT in learning activities was still not optimal. Lecturers are expected to be able to convey material in a concrete way so that students can understand it better and avoid misconceptions. Cognitive Load Theory is used as one of the factors considered in analyzing student learning needs, which states that effective learning requires delivering information in a way that does not burden students' cognitive capacity [1]. Therefore, delivering material through interactive and easy-to-understand media is very important in the context of computer networking learning.

One solution to clarify the delivery of material and overcome errors in understanding concepts is to use technology-based learning media, especially Android-based applications. At PTIK, Android-based learning media in teaching Computer networkings has never been used, although printed modules are still the main media. In fact, Android devices, with their open-source nature, offer greater flexibility and accessibility, thus enabling more interactive and in-depth teaching in computer networking concepts.

Learning media has a central role in supporting the knowledge transfer process, media is a means of communication that connects the source of information with the receiver [2]. In the context of learning, Android-based media allows for more dynamic interaction between teachers and students and accelerates the process of mastering material through a more adaptive approach. By using Android-based devices, students can access information directly, which in turn will increase their engagement and understanding of computer networking material.

The development of Android-based learning media is very relevant to support the effectiveness of Computer networking learning [3]. This research aims to analyze the need for the development of Android-based learning media in the school environment. Need analysis in the context of knowledge portals can improve the effectiveness of knowledge management and the efficiency of the learning process [4]. In this context, the application of Android-based learning media can play a similar role by supporting more effective and interactive Computer networking teaching.

The problem formulation in this study includes several key questions: (1) Do students already own a smartphone device with Android operating system? (2) Do students agree to the use of Android-based learning media in teaching Computer networkings? and (3) What obstacles might be faced by students if Android-based learn-

ing media is implemented? This research is expected to make a significant contribution to the development of learning methods that are more efficient, modern, and in accordance with the needs of education in this digital era.

2 Literature Study

2.1 Needs Analysis

Needs analysis is an important first step in the development of a learning system. Needs analysis aims to identify and bridge the gap between current conditions and expected conditions in the learning process [5]. Needs analysis in the context of learning is often used to understand students' and teachers' preferences, abilities and barriers in using certain learning media or methods. This is in line with the ADDIE model (Analyze, Design, Develop, Implement, Evaluate), where the analysis phase becomes the foundation in determining the right content, media, and learning methods [6]. In the context of Android or Augmented Reality-based media, needs analysis is important to determine features that are relevant to the learning characteristics and technological capabilities available.

2.2 Learning Media

Learning media is one of the important elements in the modern education process. Learning media as a means or tool used to transfer information from the source to the receiver (learner) [7]. This media can be in the form of books, videos, computer-based applications, or even Augmented Reality-based simulations. Learning media that combines visualization, text, and sound in a balanced manner can reduce the cognitive load of learners, allowing for more effective information processing [8]. Therefore, the selection and development of learning media should be based on learning theory that considers visual, auditory, and kinesthetic aspects, according to the needs of students.

2.3 Augmented Reality (AR)

Augmented Reality (AR) technology is one of the innovations that allows interaction between the real world and virtual objects through electronic devices. AR is a technology that combines the real world with computer-generated virtual elements, where these virtual objects can interact in real-time [9]. AR has great potential in the field of education because it allows students to interact with objects that are difficult to explain verbally or visually static, such as in Computer networking learning [10]. AR in learning increases student engagement and participation as they can manipulate and understand abstract concepts more concretely. Students learn better through hands-on experiences that allow them to build their own understanding of a concept [11].

2.4 Computer networkings

Computer networkings are infrastructures that connect various computer devices to exchange information and resources. Computer networkings are di-vided into several topologies, namely bus, ring, star, mesh, and hybrid [12]. Knowledge of computer networkings is important in the era of modern tech-nology, because networks are the backbone of digital communication, both on a local (Local Area Network - LAN) and global (Wide Area Network - WAN) scale [13]. In the context of learning, an understanding of computer network-ings helps students to understand how data and information are transmitted, accessed and protected in connected systems. In addition, with the develop-ment of cloud technology and the internet of things (IoT), an understanding of computer networkings is becoming increasingly important to support other technological innovations, such as AR and Android-based learning.

2.5 Android

Android is a Linux kernel-based operating system developed by Google and has an open source nature, allowing developers to modify and create applica-tions as needed. Android has become a major platform in learning application development due to its wide accessibility and flexibility in application crea-tion. In the context of mobile-based learning, Android is one of the most wide-ly used platforms because it supports various media formats and allows the de-velopment of interactive learning applications. The perceived ease of use and perceived usefulness of Android technology increases the adoption rate among students and teachers [14]. Android-based applications allow students to learn independently and flexibly, with access to a variety of interactive and easily accessible educational materials.

3 Research Methodology

The research method used in this study is a quantitative descriptive method with a survey approach, which aims to describe existing phenomena or condi-tions in a systematic and measurable manner. This research was conducted in the Program Studi Pendidikan Teknologi Informatika dan Komputer environ-ment of Universitas Negeri Medan, focusing on students of class 2021. In the context of information technology education, the use of quantitative methods is considered relevant because it allows objective measurement of student per-ceptions and needs.

The population in this study included all students from three classes (classes A, B, C and D) with a total of 119 students. The sample technique used was a saturated sample, which means that the entire population was sampled in this study. This approach was chosen so that every member of the population has an equal opportunity to provide their views, as well as to ensure the accuracy and completeness of the data obtained. By involving the entire population, the re-sults of this study are expected to represent the majority perception and pro-vide a strong foundation for the develop-ment of Android-based learning media.

The data collection process was conducted using an indirect communication method with an instrument in the form of a questionnaire. Questionnaire is an ideal data collection tool in quantitative research because it allows respondents to provide answers independently and objectively. Before the questionnaire is distributed, a demonstration of the Android-based learning media that will be used in the learning process is first carried out. The purpose of this demonstration is to equalize the perception among respondents regarding the learning media to be evaluated, as well as to give them a clear picture of the features and benefits offered by the media.

The demonstration is conducted by showing various interactive features of the learning media, including the type of material presentation format, such as video, interactive quiz, and text module. This is important because Android-based learning media offers a variety of information delivery approaches that can be tailored to individual learning styles. After the demonstration is complete, students are given the opportunity to try the media directly, so that they can feel the benefits and shortcomings before giving an assessment in the questionnaire.

After the demonstration and exploration process was completed, a questionnaire containing questions related to the needs and expectations for the development of Android-based learning media was distributed to all respondents. This questionnaire was designed to explore students' views regarding important aspects in media development, such as reliability, accessibility, usability, and content relevance to academic needs. The use of questionnaires as a data collection tool allows researchers to obtain more structured data and facilitate statistical analysis.

The data collected from the questionnaire was then analyzed using quantitative descriptive methods. Respondents' data were grouped based on the answers given, and each group of answers was measured in percentage form. This analysis aims to identify general patterns in students' responses, as well as to evaluate their level of need and readiness in using Android-based learning media. With a quantitative approach, the results obtained can be more easily interpreted and used as a basis for further decision making related to media development.

The use of quantitative descriptive methods also allows the identification of the most influential variables in the development of Android-based learning media. For example, this analysis can reveal the extent to which technological accessibility, students' ability to use digital devices, and the relevance of media content to the curriculum are key factors in the successful implementation of learning media. In addition, the results of this study can also provide concrete recommendations related to technical and pedagogical aspects that need to be improved in media development.

The importance of need analysis in the context of learning media development cannot be ignored. Based on the theory of *Instructional Design*, needs analysis is an essential early stage in designing an effective learning media. By analyzing user needs (in this case students), media developers can ensure that the media produced is in accordance with academic expectations and needs, so that it can be used optimally in the learning process.

4 Result and Discussion

The data used in this study were obtained through questionnaires filled out by respondents. The questionnaire is a combination of closed and open-ended questions designed to explore students' perceptions regarding the use of An-droid-based learning media. In question number 1, the question is closed-ended with two answer options, namely “Yes” and “No”. In question 2, there are “Yes” and “No” answer options accompanied by further reasons. Meanwhile, question number 3 is open-ended to provide space for students to explain the obstacles they may face.

Question No. 1: Do you have a smartphone with the Android operating system?

Based on data analysis from 119 respondents, it was found that 117 re-spondents (98.3%) owned a smartphone with the Android operating system, while 2 respondents (1.7%) did not own such a device. This distribution shows that the great majority of students already have access to Android-based devic-es, which is the main foundation in implementing Android-based learning me-dia in the classroom. This technological readiness is important in adopting ed-ucational technology, where users' technological readiness is key in the suc-cessful implementation of innovations [15]. The high percentage of students who own Android devices indicates that they can easily access learning media based on this technology. In addition, the availability of these devices is a de-termining factor in creating a more interactive learning environment and sup-ported the use of technology in education.

Question No. 2: Do you agree if the Introduction to Computer networkings material uses Android-based learning media?

Based on the respondents' answers to question number 2, all 119 respond-ents (100%) agreed that Android-based learning media can be used in the in-troduction of Computer networking material. None of the respondents rejected the application of this technology, which shows full support for mobile-based digital learning innova-tions. Students at the University of Islam Indonesia (UII) fully support the implemen-tation of e-learning [16]. Positive perceptions to-wards the use of Android in learning provide added value in facilitating stu-dents' active engagement in learning as can be seen from Table 1 [17].

Table 1. Reasons Respondents Agree with Computer Hardware Introduction Material Using Augmented Reality Android-Based Learning Media

No	Questions	Respondents	Percentage
1	Display objects are 2D or 3D	25	21%
2	Facilitate the learning process	22	18,5%
3	Does not require internet access	12	10%
4	The learning media is interesting	18	15,1%
5	Talent development	7	5,9%

6	Keeping up with technological developments	6	5%
7	Get new knowledge	7	5,9%
8	Increase in learning motivation	9	7,5%
9	Accelerate understanding of the material	9	7,5%
10	Learn anywhere and anytime	4	3,6%
Total		119	100%

The main reason underlying respondents' approval of the use of Android-based media is the platform's ability to visually and interactively display learn-ing objects and concepts that visualization can affect increases memory up to 30%, compared to just hearing (20%) or reading (10%) [18]. In the context of Computer networking learning, visualization presented through Android allows students to see network simulations, topology diagrams, and hardware realisti-cally, which strengthens their understanding of the material.

Android apps are able to visually display route navigation and destinations, creating the illusion that the objects are real in the physical world [19]. An-droid-based educational games can increase students' engagement and critical thinking skills, which indirectly contribute to improved learning outcomes [20].

Question 3: If you answered “Yes” to Question 2, what obstacles might you face if Android-based learning media is implemented?

The analysis of question number 3 shows that the biggest obstacle that stu-dents might face is the lack of understanding on how to use Android-based learning media. 72% of the total respondents mentioned that they are not fa-miliar with the use of learning applications on Android, so they need more structured guidance. This limitation demands a more comprehensive training or tutorial, which not only teaches how to use but also provides simulations and practical examples which emphasizes the importance of instructional sup-port in helping students achieve more complex skills as can be seen from Table 2 [21].

Table 2. Obstacles that Students May Face in Implementing Android-Based Learning Media.

No	Questions	Respondents	Percentage
1	Not yet understanding the use of media	85	71,5%
2	Does not meet the minimum phone specification require-ments	9	7,5%
3	Without problem	25	21%
Total		119	100%

In addition, 25% of respondents identified the limitations of smartphone specifica-tions as a potential constraint. They stated that not all devices they own are capable of running Android-based learning apps smoothly. Therefore, app development should consider optimizations that allow apps to run on de-vices with minimal specifications.

This is in line with the Universal Design for Learning (UDL) theory, which emphasizes that accessibility should be a priority in educational technology development.

As many as 3% of respondents mentioned other obstacles such as technical glitches or unstable internet connection, which can affect the use of Android-based learning media. Therefore, it is important for media developers to consider alternative solutions, such as offline mode, to reduce dependence on internet connection.

To overcome the various obstacles identified, it is important for Android-based learning media developers to create an application that is easily accessible and usable by all students, regardless of the variety of devices they own. The use of intuitive interface, interactive guides, as well as content optimized for low-specification devices should be the main focus in the app design.

Furthermore, the utilization of blended learning can be an ideal solution to combine the advantages of Android technology with conventional teaching methods [22]. This model allows students to learn independently through the app, while getting direct guidance from the teacher when facing technical or conceptual obstacles. The importance of a balance between technology and direct interaction in education [23]. Based on the results of data analysis, the application of Android-based learning media in the introduction of Computer networking material is well received by students. However, some technical obstacles still need to be overcome so that the implementation can run effectively and efficiently.

5 Conclusion

Based on the data analysis that has been done, several conclusions can be drawn as follows: (1) Of the total 119 respondents, 117 students (98.3%) have Android-based smartphones, while only 2 students (1.7%) do not have such devices. This shows the readiness of most students in adopting Android-based technology to support digital-based learning. (2) All respondents, namely 100% of students, agreed with the implementation of Android-based learning media for the Computer Networking subject. The main reason for this agreement is the ability of Android media to display 2-dimensional and 3-dimensional visualizations that help understanding concepts, which were identified by 23.1% of respondents. This visualization makes it easier for students to learn network topology and computer hardware more concretely. The full support from these respondents shows that Android-based media can play an important role in increasing the effectiveness of technology-based learning. Complex visualizations can reduce students' cognitive load, allowing them to focus more on understanding the core material [1]. Simultaneous use of visual and verbal representations can deepen students' understanding, and in this context, Android-based media provides an ideal platform for this [24]. (3) The main obstacle faced in implementing Android-based learning media is the lack of students' understanding of how to use the media. As many as 69.2% of respondents identified this as a major problem, which emphasizes the need for additional guidance and training in the use of learning applications. On the other hand, 24.6% of students stated that the limitations of their smartphone specifications were a challenge in using this learning media. Factors such

as perceived ease of use and accessibility of technology affect the level of adoption and effectiveness of educational technology implementation [25].

As an implication of this finding, it is recommended that Android-based learning media developers consider technical aspects such as optimizing applications for devices with minimal specifications, without sacrificing content quality. In addition, to overcome the problem of understanding usage, a comprehensive training program or tutorial is needed to equip students with the necessary skills. These steps are expected to increase the efficiency of implementing Android-based learning media and provide a more effective learning experience for students.

Overall, the results of this study indicate the great potential of Android-based learning media in supporting Computer networking learning. However, to achieve maximum benefits, greater efforts need to be made in terms of training in the use and optimization of the software, according to the conditions and needs of students.

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