



Analysis of K3LH learning media needs in the field of Computer Network Engineering and Telecommunications based on Augmented Reality

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Abstract -This study aims to perform a requirements analysis for the development of Augmented Reality (AR) learning media focused on Health, Safety, and Environment (K3LH) content for tenth (X) grade students in the Computer Network and Telecommunications Engineering Study Program (TJKT) at State Vocational High School (SMKN) 2 Padang Panjang. Based on initial observations, instruction on Health, Safety, and Environmental Protection (K3LH) remains conventional and lacks interactivity, which impacts students' understanding of the subject matter and K3LH tools. This study employs a qualitative approach, using data collection techniques such as interviews and observations with teachers and students. The analysis results indicate that students require learning media that can display realistic, interactive, and engaging visualizations of objects and be accessible via mobile devices. Media tailored to students' needs is expected to enhance learning interest, active engagement, and understanding of the learning material. Therefore, the development of AR-based learning media must be aligned with students' characteristics and expectations to be more effective in supporting the learning process.

Keywords— Augmented Reality; Learning Media; K3LH; TJKT; Need Analysis;

I. INTRODUCTION

Education is a deliberate and structured effort to build an environment and learning process that encourages students to actively develop their potential, enabling them to develop spiritual and moral values, self-discipline, character, intelligence, integrity, and skills needed for personal growth, as well as to contribute to society, nation, and state [1]. Education also seeks to form a complete individual both physically and mentally, healthy, and virtuous. The formation of a complete human being can be achieved by maximizing the quality of learning. In this context, the applied curriculum has an important role to support the achievement of these educational goals, currently the latest curriculum development is the Independent Curriculum.

To support the optimal implementation of the Independent, effective learning tools that can attract students' interest in learning are needed. One important element in this regard is learning media. Learning tools are media specifically designed to stimulate learners' thoughts, feelings, attention and desire for

learning to take place. Learning tools contain information that can be represented as knowledge and the means for learners to carry out learning activities [2]. The use of various forms of media can improve the quality of learning in today's digital age. The use of appropriate learning media can significantly improve the quality of learning and encourage active student participation in the classroom. The use of digital learning media in differentiated learning has been proven to increase students' interest, motivation, and understanding of the subject matter. In fact, there has been a significant increase in student motivation to learn after the implementation of digital learning media [3].

However, despite the many benefits of digital media that have been proven by previous studies, the reality in the field shows a different picture. Based on observations during the implementation of the Educational Field Practice at SMKN 2 Padang Panjang, in the Computer Network and Telecommunications Engineering (TJKT) department from July to December 2023, it was found that many students still had difficulty understanding the lesson material due to the lack of interactive learning media. This situation is particularly evident in the subject of Computer Networking and Telecommunications Fundamentals, especially in topics related to Health, Safety, and the Environment (K3LH). In fact, many students are still unfamiliar with the tools related to K3LH. The problem of low student understanding is increasingly evident from the summative assessment results obtained, as presented in Table 1 below.

TABLE 1
SUMMATIVE ASSESSMENT X GRADE TKJT

Student Scores	Number of students
<60	16
70	7
80	9
90	2
100	0

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Table 1 shows the summative assessment of X grade TKJT students on K3LH elements in the 2023/2024 academic year. Based on this data, almost half of the students obtained scores below the Minimum Passing Criteria (KKTP), which is 70. This means that more than half of the students in that class have not achieved satisfactory results. This situation is attributed to low student interest and understanding of the material, which was delivered through lectures using unengaging teaching materials. Additionally, the limited availability of K3LH teaching aids at the school has contributed to students' lack of understanding regarding occupational safety and health, despite the importance of mastering this subject matter as preparation for future internships. Therefore, an innovative and interactive learning approach tailored to the characteristics of K3LH material is urgently needed.

One effective way to improve students' understanding and motivation to learn is to utilize interactive learning media. The integration of interactive media can enhance how material is delivered and spark students' interest by presenting content in a more engaging and easily digestible format. Beyond just improving conceptual understanding, interactive media also plays a valuable role in supporting students' psychological development and boosting their confidence and encouraging them to take a more active role in the learning experience [4].

One type of interactive media that is becoming increasingly popular and has great potential for use in education is Augmented Reality (AR)-based media. AR media allows students to see three-dimensional objects in real life through mobile devices, so that abstract material can be visualized more clearly and interestingly. This media also provides a more interactive and contextual learning experience, in line with the characteristics of today's digital generation students. Previous studies have shown that AR media can significantly enhance motivation, interest in learning, and conceptual understanding, particularly in learning contexts that require the visualization of tools or work processes. such as occupational safety and health training

Because mobile phones are widely used by students, integrating AR into mobile-accessible learning media can redirect students' attention toward more productive activities. This is expected to increase students' enthusiasm for learning, thereby reducing the previous use of mobile phones for less useful purposes. Learning media is a means of communication in print, visual, and audio forms, including hardware technology[5]. Interactive multimedia refers to a multimedia presentation created by designers to deliver messages while allowing users to engage and interact with the content. Multimedia has many uses, including learning media, games, films, medicine, the military, business, sports, advertising/promotion, and others. If users have the freedom to control the multimedia, then this is referred to as interactive multimedia [6].

Augmented Reality is an innovative technology that can combine digital objects and information into the real world in real time, creating an interactive experience that expands the user's perception by adding digital elements to their physical environment [7]. Augmented reality enhances an individual's perception of their surroundings by blending elements of the virtual and real worlds into a unified interface that presents useful information. This technology proves highly valuable in

areas such as education, training, maintenance and repair, manufacturing, the military, gaming, and a wide range of entertainment applications [8]. In the context of K3LH learning, AR can be used to simulate work environments, safety procedures, and how to use personal protective equipment safely and immersively, without any direct risk in the real world.

However, the development of AR-based learning media must be preceded by an analysis of students' needs to ensure that the developed media aligns with their characteristics, expectations, and learning requirements. This needs analysis is crucial for identifying the types of visualizations, features, and learning approaches that students consider effective. Based on this background, this study aims to analyze the needs in the development of AR-based learning media required by grade X students at SMKN 2 Padang Panjang in K3LH material.

II. METHOD

This study used a qualitative descriptive method with data collection techniques through observation and interviews to explore the needs for Health, Safety, and Environment (K3LH) learning media at SMK Negeri 2 Padang Panjang. The sampling technique used was purposive sampling, with criteria including the top 3 students, the bottom 3 students, and 2 teachers of the TKJT subject, resulting in a total of 8 informants. The research instrument consisted of an interview guide developed based on indicators for students, including learning experiences, learning challenges, media used, strengths and weaknesses of current media, needs for new media, and the impact of media on learning motivation.

III. RESULTS AND DISCUSSION

Based on observations conducted at SMKN 2 Padang Panjang, several issues and needs related to the learning process were identified, particularly regarding the subject of Occupational Health, Safety, and Environmental Protection (K3LH) in the grade X Computer Networking and Telecommunications (TKJT) vocational program.

The first prominent issue is that the learning system is still dominated by lecture-based methods using conventional media such as textbooks, modules, and PowerPoint presentations (PPT). Although the material is available in text and image formats, its presentation is limited to two dimensional visuals, which fail to adequately depict the actual form and function of K3LH tools. As a result, students face difficulties in understanding the material deeply because they cannot see, touch, or interact directly with the objects described by the teacher. Learning tends to be passive, with student activities limited to note taking or listening without active engagement in exploring the material.

The second problem is the suboptimal use of technology, particularly smartphones. Although schools have given permission to use smartphones in the learning process, in reality, these devices are not being used to their full potential to support learning activities. Many students instead use smartphones to access social media or play games outside the context of learning. The great potential of technology as an interactive and flexible learning tool has not been maximized, either by students or teachers.

The impact of various problems in learning is evident in the low achievement scores of students, which are still below the Minimum Passing Criteria (KKTP). This condition is influenced by students' lack of interest and understanding of the material, which is largely due to monotonous lecture methods, the use of uninteresting learning media, and limited teaching aids, especially for K3LH material. To address this challenge, the use of more interactive learning media is needed to improve the quality of the learning process, especially in today's digital age. Interactive media can create a more lively and enjoyable learning environment, where students are not just passive listeners but can actively engage in exploring the material. This is supported by previous research findings that confirm the use of interactive learning media has a significant positive impact on the learning process and outcomes of students. This media can transform difficult material into something easier to understand, create an enjoyable learning experience, and enhance students' motivation, enthusiasm, and engagement in learning. Additionally, interactive media encourages students to be more actively involved in class and helps them achieve better academic results through visual and simulative approaches that align with their individual learning styles [9][10][11].

To further explore these issues, interviews were conducted with students to gain more insight into their experiences, challenges, and preferences regarding K3LH learning. Through these interviews, it was confirmed that students prefer learning media that are more interactive, engaging, and visually oriented. The data from the interviews with students can be seen in the following table 2.

TABLE 2
 RESULTS OF INTERVIEWS WITH STUDENTS

Questions	NMR, SR, RE	ZA, MA, RH
Can you share your experience of learning K3LH material in class?	K3LH learning is interesting and relevant to the majors taken. The material is easier to follow when accompanied by visualizations and becomes more lively when simulations are provided.	They tend to have difficulty following the material, sometimes feel confused, and some fall behind in understanding the content of the lesson.
What difficulties did you encounter when learning K3LH material?	It is difficult to imagine procedures or risky work situations if they are only conveyed in text or images. Concepts that are difficult to understand are also less clearly illustrated	They find it difficult to understand unfamiliar terms and are confused if they are not given real-life examples.

Questions	NMR, SR, RE	ZA, MA, RH
	without the aid of visualizations.	
What learning media are typically used by teachers when teaching K3LH material?	PowerPoint, textbooks, images, videos, and presentation slides.	Textbooks, slides, and presentations.
In your opinion, what are the advantages and disadvantages of the learning media used by teachers?	The media used have advantages such as clear, organized, and structured presentation of material, which helps in understanding basic concepts. However, their drawbacks include limited visualization, a tendency toward monotony, and a lack of interactivity, which can reduce learning interest.	The media used has advantages such as comprehensive material, alignment with the curriculum, and step-by-step guidance from teachers. However, the drawbacks include a lack of visualization, media that is solely image-based and boring, and an overemphasis on theory.
What kind of learning materials do you think could make it easier to understand K3LH material?	Interactive media equipped with procedure simulations, 3D objects, or workplace incident simulations make the material easier to understand.	Interactive media that displays procedure examples, personal protective equipment in 3D form, or animations of work processes.
In your opinion, does the use of learning materials affect your motivation to learn?	Media with visualization makes the learning process more engaging, helps understand the material quickly, and enhances memory retention.	Interactive media helps visualize work situations and facilitates understanding of the material even if direct practice is not yet possible.

Based on Table 2, it can be concluded that there is a strong need for more engaging, interactive, and visual learning media. Students stated that they find it easier to understand the material when it is presented with three-dimensional visualizations and live simulations. They need media that not only conveys information in text form but also provides an enjoyable learning experience and stimulates motivation to learn.

To complement students' perspectives, interviews were also conducted with K3LH teachers to gain insight into their experiences, challenges, and opinions regarding the effectiveness of learning media. The data from the interviews with teachers can be seen in the following table 3.

TABLE 3
 RESULTS OF INTERVIEWS WITH TEACHERS

Question	Answer 1 (YE)	Answer 2 (FN)
Please share your experiences in teaching K3LH material in class.	While teaching K3LH, I found this material to be highly relevant to the workplace, particularly in the fields of engineering and industry. However, challenges arose when explaining procedures that could not be directly observed by students in the classroom due to limitations in teaching aids.	In teaching K3LH, I see this material as very important before students enter the industry. Learning can be effective if students get a clear picture of safety procedures, but visualization is still a challenge.
What obstacles or challenges do you usually face during the K3LH learning process?	The main obstacle was the difficulty in providing a realistic picture of potential hazards in the workplace. Despite using illustrations and images, students still found it challenging to visualize the application of procedures in the field.	The main difficulty is conveying technical procedures in a simple manner. Many students find it difficult to visualize safety steps from text or images alone.
What learning media do you generally use in delivering K3LH material?	The media commonly used include PowerPoint presentations, textbooks, illustrative images, and occasionally educational videos.	Textbooks, PowerPoint presentations, and instructional videos.
In your opinion, what are the advantages and disadvantages of the learning media that have been used so far?	The advantage is that the material can be presented systematically according to the curriculum, making it easier for students to understand the basic concepts. However, it remains limited in	The advantage is that the presentation of the material is already quite engaging. However, there is still a lack of simulations and interaction, making it difficult for students to connect

Question	Answer 1 (YE)	Answer 2 (FN)
	visualization and lacks interactivity, making it difficult for students to imagine real-world conditions and engage actively.	theory with practical fieldwork.
In your opinion, what type of learning media is considered most effective in helping students understand K3LH material more effectively?	Interactive learning media that can realistically visualize safety procedures would enable students to understand K3LH without needing to be at the actual workplace.	Interactive learning media with simulations of work procedures that resemble real-world conditions to make learning easier for students to understand.
In your opinion, does the use of learning media have an effect on student motivation to learn K3LH material?	Influential because more interactive and visual media can improve students' understanding, memory, and awareness of the importance of workplace safety.	It is very influential, because interactive media will make learning more interesting, increase student engagement, and deepen their understanding of K3LH concepts.

Based on Table 3, the results of interviews with these teachers reinforce the need for learning media that combines visualization, interactivity, and simulation. This means that both students and teachers realize that augmented reality (AR) can be a very effective medium for improving students' understanding, motivation, and engagement in K3LH learning. The application of augmented reality in education has the advantage of being an educational medium that has a significant impact, as students find it easier to understand compared to those who do not use augmented reality [12].

Therefore, AR based learning media is considered a relevant alternative solution that addresses the needs of K3LH learning. Through AR, students can directly view and interact with three dimensional virtual objects using the mobile devices they possess. This technology enables the delivery of content through visualization, audio, and interactive simulations simultaneously. Moreover, the use of AR also serves as a strategic approach to redirect smartphone usage toward more positive and productive purposes in supporting learning activities.

This is supported by research that shows that using AR makes the learning process more interactive and helps improve student understanding, especially of occupational safety material, which is very important as preparation for practical training. This is in line with research results showing that the use of augmented reality based learning media provides

convenience and flexibility for students in understanding the material. This makes the teaching and learning process more optimal, and allows messages to be conveyed more quickly because they are supported by appropriate and suitable media [13].

According to Silvani in her research, the use of Augmented Reality (AR) based learning media has been proven to have a strong and positive impact on improving student learning outcomes. This technology not only brings a fresh approach to delivering educational content but also demonstrates significant potential as a practical innovation, particularly in vocational education settings. By providing a more immersive and interactive learning experience, AR encourages active student engagement in the learning process, thereby making education more engaging and meaningful [14].

Additionally, other opinions state that AR media can transform abstract concepts into real and interactive visualizations, thereby making it easier for students to understand spatial relationships between objects. Thus, the integration of AR technology in learning not only enhances students' understanding but also develops critical visualization skills [15].

Based on the results of observations, interviews and supported by previous research, it can be concluded that students in X grade at SMKN 2 Padang Panjang require the development of learning media that can provide realistic visualizations and integration with mobile technology. AR based learning media are believed not only to enhance understanding of K3LH material but also to encourage active student engagement in modern, engaging, and technology aligned learning processes.

IV. CONCLUSION

Based on the results of the study, it can be concluded that the learning process for Health, Safety, and Environment (K3LH) material in the X grade Computer Network and Telecommunications Engineering (TJKT) class still faces a number of obstacles. Among these are the dominance of lecture methods and the limited use of learning media, causing students to have difficulty comprehending the material thoroughly. Additionally, although the use of technology such as smartphones is permitted in learning, its utilization remains suboptimal. This situation impacts students' low learning motivation and academic achievements. On the other hand, there is a significant need from both students and teachers for more interactive, engaging, and visual learning media. Augmented Reality (AR) is considered a relevant solution as it can present learning materials in a more vivid, interactive, and appropriate manner for the characteristics of the current digital generation.

Therefore, the researchers provide several recommendations in this study. First, teachers are advised to begin experimenting with and utilizing technology based learning media, such as Augmented Reality (AR), to present K3LH material in a more realistic, engaging, and easily understandable manner for students. Second, schools are encouraged to provide adequate support, both in terms of facilities and teacher training, to ensure the optimal and sustainable use of AR based learning media in the classroom.

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