QR Code-Based Animated Videos to Improve Early Childhood Numeracy Literacy Skills

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Abstract: Early Childhood Education (PAUD) has an important role in forming the basic foundation for the development of children's cognitive abilities, including numeracy literacy. Numeracy literacy not only prepares children in the concept of number recognition, but also involves the ability to understand patterns, many-little concepts, as well as basic operations such as addition and subtraction. This study aims to explore how animated videos accessed through *QR Codes* affect early childhood numeracy literacy skills. The methodology in this study uses a descriptive qualitative approach. The data collection technique is by conducting observations, interviews with teachers and parents, and learning documentation in PAUD. Data is analyzed through several stages, namely data reduction, data presentation, data conclusion, and data validation using triangulation. The results of the study show that the use of animated videos as a learning medium accessed through *QR Codes,* is able to increase children's understanding of numeracy concepts, as well as build interest in learning. However, challenges related to limited access to technology in some areas are the main obstacles that need further attention. This study suggests the importance of developing technology-based learning media that is easily accessible and relevant to the needs of early childhood.

1 INTRODUCTION

Early childhood education is a fundamental stage in forming the basis of children's cognitive, social, emotional, and motor development. During this time, proper stimulation is needed so that all aspects of child development can grow optimally (Suryana, 2016). Cognitive abilities are fundamental that guide children's behavior, including improving the ability to understand abstract symbols in manipulating the environment. Thinking ability can affect many things, such as the ability to learn, solve problems, and speak language (Suryana, 2018). Cognitive abilities are one of the abilities that must be improved in the early years of a child which is a critical time to invest in building human resources (Pushparatnam et al., 2021). Children can learn various concepts for cognitive development, including the concepts of color, shape, direction, numbers, numbers, and others (Nurtaniawati, 2017). One of the cognitive development of children is numeracy literacy skills that need to be introduced from an early age.

Numeracy literacy is a basic skill that includes not only numeracy skills, but also an understanding of the concepts of numbers, patterns, sizes, comparisons, and simple mathematical logic. Numeracy literacy is very important to be instilled from an early age because it is the foundation for the development of logical thinking skills and problem solving in the future. Therefore, this process must be packaged in an attractive way so as not to exert pressure that can interfere with children's development (Hulukati & Yunitasari, 2024).

The use of media in the learning process aims to enrich children's learning experiences. However, the reality on the ground shows that the implementation of numeracy learning in early childhood education institutions still faces various challenges. One of the prominent problems is the lack of competence of educators in designing and implementing meaningful and contextual numeracy literacy learning (Anisa Nurmina & Mulyani, 2023). The learning approach used must be designed in such a way that it is not only fun, but also able to provide opportunities for children

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to explore and develop their potential in an integrated manner (Suryana, 2024). The concept of numeracy literacy is often presented in a monotonous and abstract manner, so that children have difficulty understanding the concepts offered. Many PAUD teachers do not have a comprehensive understanding of numeracy literacy learning strategies that are in accordance with the stages of child development (Diana Fitri et al., 2023). The lack of interesting and interactive learning media causes children to quickly lose focus and interest in learning. Effective learning media helps children recognize shapes, colors, and images, as well as improve focus and learning outcomes (Rupnidah & Suryana, 2022).

As information technology, learning methods and media undergo transformation, advances in digital technology provide a great opportunity to enrich learning methods. In this context, the integration of technology such as animated videos and QR Codes can be a medium that supports active, concrete, and appropriate learning practices in accordance with the characteristics of early childhood (Suryana, 2021). One of them is through the use of animated videos that have the potential to present the concept of numeracy literacy with attractive visuals, easy-to-understand narratives, and contextual storylines (Shofia & Dadan, 2021). However, the challenge in the implementation of digital media is the issue of accessibility and device limitations. To bridge these challenges, the use of QR Codes (Quick Response Codes) is a practical solution. With QR Codes, digital content such as animated videos can be accessed quickly by simply scanning the code through a device. When combined with educational animated videos, these media can create a more visual, auditory, and enjoyable learning experience for children (Papadakis et al., 2018; Arsyad, 2015). This approach not only makes it easier for teachers and parents, but also introduces children to the use of technology in a contextual and directed manner (Az-Zahra et al., 2025).

2 LITERATURE REVIEW

Visual/animated media to improve early reading literacy skills: for example, in elementary school students, the average score increased from 67.82 to 76.73 and classical completeness from 56.52% to 86.95% (Maryono & Budiono, 2020). QR Codes in Early Childhood Literacy A study on "QR Code-based pictorial word dice media" for children aged 5–6 years showed an increase in early reading skills among which 2 out of 5 children experienced development, while 3 others have developed as expected (Hanadiah & Rohmalina, 2023).

One of the uses of technology in the world of education, especially in learning media, is the use of QR Codes (Quick Response Codes). QR Code is a type of two-dimensional barcode introduced by a Japanese company, namely Denso Wave, in 1994. Although it has been around for almost 23 years, the benefits of QR Codes remain very significant (Majid et al., 2021). QR Codes in learning allow for the integration of multimedia information such as videos, text, and images that are easily accessible. Research on QR Code-based books shows that this media is effective in developing the cognitive aspects of children aged 5–6 years with media and material validation scores reaching the "good" category (around 78–79%), and children's assessment results reaching 85% "good" (Mowafi & Abumuhfouz, 2020).

The use of QR Codes in learning media makes it easier for educators to apply and access them. Previously, there was quite a lot of information, with the existence of a QR Code that can be stored in the form of a simple code and can be accessed quickly through a scanner. QR Codes can be placed in a variety of media, including textbooks, posters, worksheets, or presentations, making it possible to quickly access additional information, videos, websites, or other resources that support learning. However, it is important to ensure that the content delivered through QR Codes is relevant, qualified, and appropriate to the learning objectives. In addition, the use of QR codes in learning media also requires the accessibility of appropriate devices and internet connections, which may be obstacles or certain learning environments. This is a challenge and readiness to provide infrastructure facilities such as smartphones, tablets and internet connections to access the barcode so that learning media can be accessed and learned optimally.

3 METHOD

The methods section explains the research methods used including the research design, the research subject, and the research procedure.

Research Design

The methodology in this study is qualitative descriptive. Qualitative research, according to

Bogdan and Taylor, is a research procedure that produces descriptive data in the form of written or spoken words from people and observable behaviors (Moleong, 2010). Bogdan and Biklen (1982) stated that qualitative research has a natural background as a direct source of data and the researcher is a key instrument. In essence, researchers are the main data collection tool.

Research Subject
The research was conducted at one of the PAUD institutions in Padang City, Indonesia. The subjects consisted of 16 children aged 5–6 years, 1 classroom teacher, and 2 parents who were directly involved in the learning process.

Research Procedure
Data collection techniques use observation and interviews. Data collection techniques in qualitative research can generally be grouped into two methods of data collection techniques, namely interactive and non-interactive. In this study, the author uses interactive techniques including observation and interviews. The observations made were participant observations. Participant observations are in-depth observations by blending into the middle of the research subject. Marshall (2011) stated that through observation, researchers study the behavior and meaning of the behavior. Observations were carried out to determine the ability of early childhood numeracy literacy in utilizing QR Code animation videos as a learning medium. Observations are carried out in an unstructured manner. Meanwhile, interviews, according to Sugiyono (2018), are a data collection technique if the researcher wants to conduct a preliminary study to find out the problem that must be researched or if the researcher wants to know more in-depth things from the respondents.

Interviews are a data collection technique with a question and answer method that is carried out systematically based on certain objectives. Interviews were conducted with children and teachers of grade B1 Arafah Kindergarten. Through interviews, it is sought to dig deeper information about children's abilities in the field of early numeracy literacy. Interviews are conducted in a structured and face-to-face manner. The questions asked to the child are adjusted to the field conditions, meaning that the questions are natural. The questions asked were questions about the identity of the child and questions that supported the research. The interview questionnaire is as follows:

Questions for students:
What's your name? Where is your home? Who took you to school?
Let's see, what image is that? (student A: "Cow, Chicken, and Goat")
Try to count how many cows there are, how many sheep there are and how many chickens?
Try to choose which animal has a bigger body?
Sort the animals from small to large.

Questions for teachers:
Has early childhood been introduced to early numeracy literacy?
How can mothers teach the basic concept of numeracy literacy for early childhood?
What media do you use?
Are there any obstacles in children understanding the concept of numeracy literacy?

Data obtained from observations and interviews were analyzed. Data analysis was carried out qualitatively with the stages of data reduction, data presentation, and conclusion drawing (Miles & Huberman, 1994). The data is encoded and categorized into main themes such as children's attention, learning interactions, and understanding of numeracy concepts. At this stage, the author explains what is seen, heard, felt, and questioned. The author reduces all the information obtained by sorting through the data or selecting which data is interesting, important, useful, and new. Based on these considerations, the data is then grouped into various categories that are determined as the focus of the research.

The next stage is data presentation, which is the presentation of information obtained from the data reduction process, then organized and presented with a narrative text model. The next stage is the drawing of conclusions and verification of data that has been rejected, focused, and systematically compiled, then concluded, for the next search for new data, as a test of the provisional conclusions obtained.

The final step is data validation using triangulation. Triangulation is a data collection technique that combines various data collection techniques and existing data sources. Researchers are involved with the daily activities of people who are observed or used as sources of research data. Triangulation is a data validity check technique that uses other things in comparing interview results with research objects (Moloeng, 2019). The goal is to examine and compare the data. In line with this opinion, Cresswell (2014) states that data triangulation aims to compare the answers between participants and the experiences of fellow researchers who collect data.

4 RESULTS AND DISCUSSION

Varied learning media are needed to support the success of learning outcomes. QR Code learning media is an innovation in the development of learning media in the world of education. QR Code was created to facilitate and store the exchange of information quickly using electronic devices that have cameras such as mobile phones and tablets. QR Codes can be used in learning as a tool to provide direct access to a variety of educational resources including additional texts, videos, images, websites or apps that can support learning.

In this study, QR codes were placed on learning media in the form of animated videos that contain teaching materials related to the basic concept of early numeracy literacy introduction in early childhood. The animated video is uploaded on google drive then the video upload link is converted into a QR Code. Where the QR Code will be scanned by teachers, students and parents during learning. The following is the QR Code-based teaching media used in this study.

Figure 1: QR Code Animated Video.

Before starting learning activities, teachers can prepare a smartphone or tablet to scan this QR Code, the QR Code that is successfully scanned will appear a learning video in the form of animations related to the material being taught, namely the basic concept of numeracy literacy with the topic of animals and the sub-topic of livestock. Students are asked to watch the animated video and the teacher can pause the video for a moment every question which then the child is given the opportunity to answer according to the animated video he sees.

The selection of QR Codes for access to learning media is convenient for teachers and parents because through the QR Code they can be accessed easily and can be read anywhere because they can be stored on each smartphone. This study aims to examine the effectiveness of QR Code-based animated videos in improving early childhood numeracy literacy. Through a descriptive qualitative approach, the researcher collected data through observation, interviews, and documentation of learning activities in PAUD institutions using QR Code media. The results showed that the use of this media significantly increased the attention, active participation, and basic numeracy understanding of children aged 5–6 years. The use of QR Code-based animation videos in numeracy learning has been proven to provide effective stimulation for early childhood, especially in terms of number recognition and simple counting concepts. This is in line with the view of Suryana (2018), who emphasizes the importance of stimulation during the golden age of child development to optimize all aspects of cognitive ability, including numeracy skills.

One of the main findings shows that children become more focused and enthusiastic in participating in numeracy activities when learning media is delivered through animated videos accessed using QR Codes. Children show high interest by actively scanning the QR Code using the device provided by the teacher, listening carefully to the video, and following the song or numeracy instructions in the video. This interest creates a conducive learning atmosphere, where children who were previously less focused on learning become more cognitively and emotionally engaged. This is in line with the multisensory learning theory which states that visual and auditory stimulation can strengthen information absorption in early childhood (Arsyad, 2015).

In addition to increasing attention, the use of animated video media also contributes to accelerating the understanding of numeracy concepts. In the two weeks of the activity, most of the children were able to recognize the numbers 1 to 20, count the number of objects, and understand larger and smaller concepts. This ability develops faster than conventional methods previously used by teachers. The teacher stated that video media helps to strengthen the visualization of the concept of numbers, because children not only hear explanations, but also see concrete representations in the form of animations and songs. Thus, children more easily associate number symbols with actual numbers, reinforcing their numerical mental representation as described in Piaget's theory of constructivism (Slavin, 2012).

Researchers also found that children began to show independence in the learning process. This attitude shows the emergence of intrinsic motivation in the numeracy learning process, where children feel happy and interested in learning without pressure from teachers or parents. Some children even show

the initiative to share with friends, suggesting that this medium also stimulates social interaction and cooperation between children. This corroborates Vygotsky's theory of the importance of social aspects in early childhood learning, where interaction with the environment and technology can accelerate the development of the child's proximal zone (Vygotsky, 1978).

The response of teachers and parents to the use of QR Code media is also very positive. Teachers feel helped in delivering material because animated videos are visually able to simplify abstract numeracy concepts (Sholikah & Lestari, 2022). On the other hand, parents find this medium practical and interesting because it can be accessed at home just by scanning the code using a smartphone (Yulianingsih & Hadi, 2020). This creates a continuity of learning between home and school, as well as strengthens parental involvement in children's education. With QR Codes, children can learn in a flexible and fun atmosphere, even outside of formal learning hours.

However, this study also noted challenges in its implementation, namely limited devices and internet connections are obstacles for some PAUD institutions and parents. Nonetheless, these barriers can be overcome by providing shared devices in schools, as well as brief training to teachers and parents on how to use QR Code technology optimally (Wu et al., 2012; Resa et al., 2024).

Overall, the findings of this study are consistent with previous studies that showed that QR Code-based learning media and digital animation can improve the cognitive aspects of early childhood (Putri, 2023; Rosyidah et al., 2024). The descriptive qualitative approach in this study allows a thorough exploration of children's learning experiences and adult perceptions, as well as provides an overview of the context of real technology implementation in the PAUD classroom. By integrating simple yet interactive technology like QR Codes, learning numeracy in early childhood can become more engaging, fun, and meaningful.

5 CONCLUSIONS

QR Codes have been widely used in various fields of life. QR Codes can also be used in the world of education. The use of QR Codes in this study is placed in learning media in the form of animated videos. QR Code-based learning media can provide convenience for teachers and parents to access information provided by educators. The use of animated videos based on QR Code technology has been proven effective in improving early childhood numeracy literacy. This media is able to attract children's attention, accelerate the understanding of number concepts, and encourage independence and motivation to learn. Children become more active and involved in the learning process, while teachers and parents consider this medium practical and supports learning at home. Despite technical challenges such as device and connection limitations, these barriers can be overcome with simple mentoring and training. Thus, this media is worthy of being developed and applied more widely in the early childhood education environment.

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