

ARTICLE

Management of Multimedia Learning Media in Early Childhood Education Classes

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Abstract

This study aims to analyse the management of multimedia learning media in early childhood classes, with the components of planning, development, implementation, evaluation and feedback, maintenance and updating, and training and support. This study uses a survey method with a quantitative approach. The research used a structured questionnaire with closed questions for getting the data distributed to 303 respondents of early childhood teachers. They were analysed using SPSS application. The findings show that in managing multimedia learning tools, most teachers—whether they design their own media or adapt it from other sources—share several common views. First, multimedia planning should be aligned with the learning objectives and context. Second, the development process needs to emphasize student engagement, which involves conducting needs analysis, considering learner characteristics, applying multimedia principles (such as coherence, redundancy, temporal contiguity, and modality), and integrating sound instructional design. Third, the use of multimedia is seen as highly beneficial for students. Fourth, regular evaluation is essential to measure its effectiveness and to give students opportunities to provide feedback. Fifth, teachers must ensure that multimedia content stays relevant and updated in line with current themes. Finally, teachers highlight the importance of adequate training in effective multimedia use, as well as broader support to ensure accessibility, including for students with special needs. The researchers recommend that results of this study be a guideline for teachers in managing multimedia learning media in early childhood classes.

Keywords: Multimedia Management, Learning Media, Early Childhood Education

1. Introduction

In recent years, education has utilized technology ([1]) because technology can help us to make learning easier and more up-to-date ([2]). Therefore, teachers must be able to use technology to support their learning (H[3]). One thing that teachers can do is to use learning media that is in accordance with technological developments ([4]; [5]; [6]). Besides that, multimedia transforms abstract concepts into concrete content, integrating visuals and auditory ([7]; [8]; [9]; [10]).

learners to process knowledge through both visual and verbal modes ([7]). Furthermore, multimedia facilitates meaningful changes in students' learning by providing access to information, supporting adaptation to new knowledge, and encouraging the development of effective learning strategies that maximize outcomes ([11]). Therefore, multimedia can be regarded as a vital instrument for enhancing the effectiveness of the teaching and learning process.

Multimedia-based learning serves as an effective approach to enhance both teaching and learning processes. Information delivery becomes more efficient through multimedia, as it has been shown to strengthen memory retention and accelerate the transfer of knowledge during learning activities ([12]; [13]; [14]; [15]; [16]). Beyond efficiency, multimedia is readily accessible to students inside and outside the classroom ([6]), fostering motivation, sustaining engagement, and increasing learners' interest and attention ([7]; [17]); [18]). From the teachers' perspective, multimedia also simplifies the delivery of more varied and engaging instructional content ([19]).

Although multimedia has many benefits, there is a problem in using multimedia, namely, ensuring that the technology used is appropriate for children's development. If the technology used does not match the needs and abilities of children, it will make children feel overwhelmed. To overcome this problem, the type of technology used in early childhood learning, how to apply it, and training for early childhood teachers must be considered to ensure that the teachers use technology in a way that supports children's developmental needs ([20]). Another problem is that teachers still need to learn how to choose and determine the right learning media to achieve learning goals effectively in teaching and learning activities ([21]). Thus, learning media management is needed ([22]). Management of learning media includes planning, selection, use, and maintenance of learning media organized by the school and used in an educational institution ([23]). There are six components of learning media management, namely: planning, development, implementation, evaluation, maintenance and updating, training, and support ([24]).

Previous studies have discussed the effectiveness of using multimedia in online and offline learning in early childhood education ([25]; [26]; [27]) and discussed the types of multimedia used in early childhood classes ([28]; [29]; [30]). Research that focuses on the management of multimedia learning media is still rare. However, the management of learning media is very important for the success of the learning process. To overcome this gap, the researchers conducted research on the management of multimedia learning media in early childhood classes. This study supports previous research conducted by [23], [24], and [31].

This study aims to describe the management of multimedia learning media in the learning process of early childhood classes, with the following components: planning, development, implementation, evaluation, maintenance and updating, training, and support.

2. Methods

This research used a survey method with a quantitative approach. It also used a structured questionnaire with closed-ended questions as the instruments for collecting the data. The research instrument is a structured questionnaire with closed-ended questions. The questionnaire used was tested limited to 30 respondents. According to the results of the limited test, 28 indicators were valid and 3 invalid. The source of the data was taken through a Google form. The respondents were early

childhood education teachers who are members of the Early Childhood Educators Association (Himpaudi), with a total of 303 respondents aged 26-45 years. Data analysis was carried out using the SPSS application.

3. Results And Discussion

3.1 Results

Table 1. Results of the validity test of the research instrument.

r count	r table	Result
0,457	0,360	valid
0,352	0,360	Invalid
0,335	0,360	Invalid
0,380	0,360	valid
0,851	0,360	valid
0,744	0,360	valid
0,618	0,360	valid
0,625	0,360	valid
0,699	0,360	valid
0,847	0,360	valid
0,746	0,360	valid
0,780	0,360	valid
0,772	0,360	valid
0,746	0,360	valid
0,691	0,360	valid
0,805	0,360	valid
0,795	0,360	valid
0,745	0,360	valid
0,716	0,360	valid
0,791	0,360	valid
0,869	0,360	valid
0,698	0,360	valid
0,690	0,360	valid
0,801	0,360	valid
0,675	0,360	valid
0,690	0,360	valid
0,541	0,360	valid

0,269	0,360	Invalid
0,388	0,360	valid
0,427	0,360	valid
0,400	0,360	valid

Based on the table above, the results show that there are 3 invalid items because $r \text{ count} < r \text{ table}$.

Table 2. Reliability Test.

Case Processing Summary			
		N	%
Cases	Valid	30	100.0
	Excluded ^a	0	.0
	Total	30	100.0

Prerequisite test

Table 3. Tests of Normality

Kolmogorov-Smirnova				Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Hasil	.327	303	.000	.718	303	.302
a. Lilliefors Significance Correction						

The normality test was conducted to determine whether the data used is normally distributed, and it is a prerequisite test before conducting an effectiveness test. Based on Table 3, the Shapiro Wilk sig value is $0.302 > 0.05$, and therefore, it can be concluded that the media management data is normally distributed. For that reason, the assumption of normality in the effectiveness test has been met

Effectiveness test

Table 4. One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Hasil	303	3.12	.376	.022

Based on Table 4, the one-sample statistics above shows the descriptive statistical values, namely $N = 303$, meaning the number of samples used is 303 respondents. Mean = 3.12, meaning the arithmetic average is 3.12. The standard deviation is 0.376, and the standard error of the mean is 0.022.

Table 5. One-Sample Test

Test Value = 3

95% Confidence Interval of the Difference						
	T	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Result	5.541	303	.000	.120	.08	.16

Based on Table 5, one one-sample test above is known that the t-value (t-count) is 5.541. The df value (degree of freedom) or degree of freedom is 303. With t-table with 303 samples of = 0.113. From the results of the data above, it is obtained t-count = 5.541 > t-table = 0.113. Therefore, H_0 is rejected and H_a is accepted. It can be concluded that the Management of Multimedia Learning Media in Early Childhood Classes is effective, both media made by educators themselves or media adopted from other sources that are ready to use

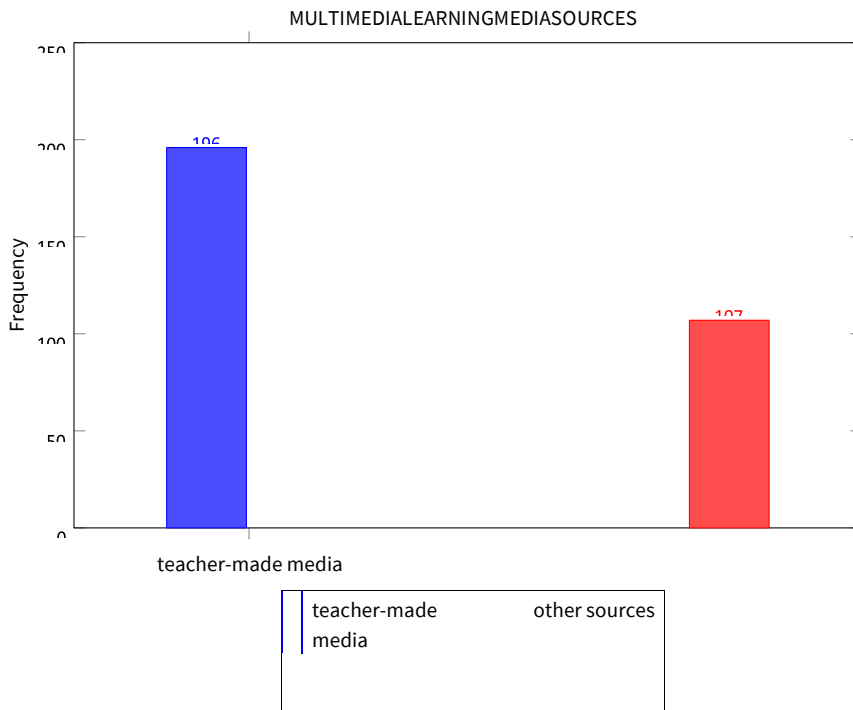


Figure 1. Multimedia learning media sources used by teachers

Graph 1 shows that 196 teachers chose to create their own learning media, while 107 teachers chose to adopt media from other sources, such as YouTube, TikTok, Instagram, or ready-to-use media.

Graph 2 shows the components of management of multimedia learning media in early childhood education viewed from teachers who create their own multimedia and those who adopt multimedia from other sources. The components are planning, developing, implementing, evaluating and getting feedback, maintaining and updating, training and supporting.

Regarding the components of multimedia learning planning, namely the selection of learning media must consider the learning objectives to be achieved and the learning context in early childhood classes, based on Diagram 2, it is known that teachers who create their own multimedia learning media, 23% stated strongly agree, 75% agree, 1% disagree, and 0% strongly disagree. While teachers who adopt multimedia learning media from other sources, 18% stated strongly agree, 82% agree, 0% disagree, and 1% strongly disagree.

Regarding the components of multimedia learning development, namely paying attention to student involvement (needs analysis and adjusting student characteristics), multimedia principles (coherence principle, redundancy principle, temporal contiguity principle, and modality principle) and instructional design, based on Graph 2, it is known that teachers who create their own multimedia learning media, 19% stated strongly agree, 76% agree, 1% disagree and 4% strongly disagree. While teachers who adopt multimedia learning media from other sources, 18% stated strongly agree, 77% agree, 0% disagree, and 5% strongly disagree.

Regarding the components of multimedia learning implementation, namely the use of multimedia, has many benefits for students. Based on Graph 2, it is known that teachers who create their own multimedia learning media, 24% stated strongly agree, 71% agree, 1% disagree, and 3% strongly disagree. While teachers who adopt multimedia learning media from other sources, 22% stated strongly agree, 74% agree, 0% disagree, and 5% strongly disagree.

Regarding the components of evaluation and feedback, namely periodic evaluation of multimedia

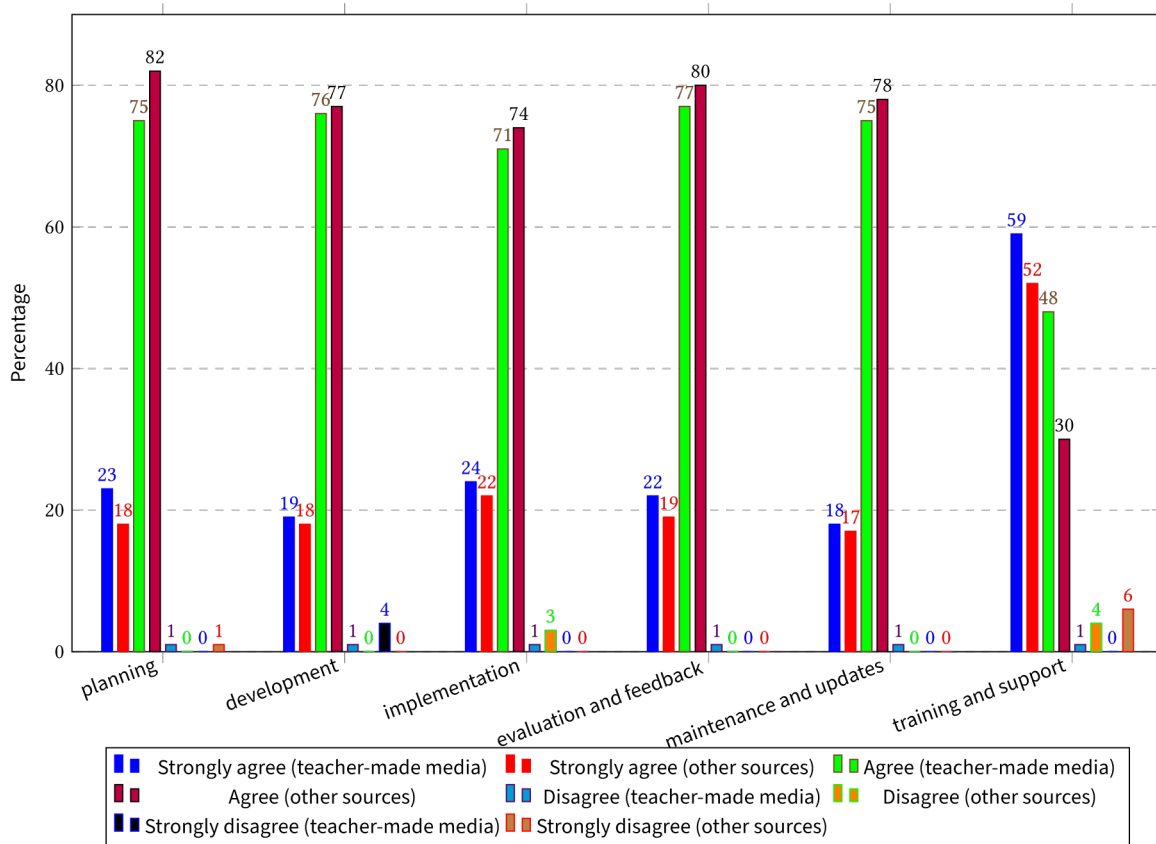


Figure 2. Components of managing multimedia learning media

usage to assess its effectiveness and provide opportunities for students to give feedback on the use of the multimedia, based on Graph 2, it is known that teachers who create their own multimedia learning media, 22% stated strongly agree, 77% agree, 1% disagree and 1% strongly disagree. While teachers who adopt multimedia learning media from other sources, 19% stated strongly agree, 80% agree, 0% disagree, and 0% strongly disagree.

Regarding the components of maintenance and renewal, namely teachers as facilitators must ensure that the content remains relevant and up-to-date according to the latest themes in the early childhood classes, based on Graph 2, it is known that teachers who create their own multimedia learning media, 17% stated strongly agree, 78% agree, 1% disagree and 4% strongly disagree. While teachers who adopt multimedia learning media, 18% stated strongly agree, 75% agree, 0% disagree, and 7% strongly disagree.

Regarding the components of training and support, namely the need for adequate training for teachers to use multimedia effectively and the availability of support in the form of multimedia that can be used by all parties including students with special needs, based on Graph 2, it is known that teachers who create their own multimedia learning media, 59% stated strongly agree, 48% agree, 1% disagree and 4% strongly disagree. Meanwhile, teachers who adopt multimedia learning media, 52% stated strongly agree, 30% agree, 0% disagree, and 6% strongly disagree.

3.2 Discussion

This research focuses on the management of multimedia learning media for early childhood education, encompassing planning, development, implementation, evaluation and feedback, maintenance and updates, training, and support. Media management is reviewed based on the media sources used by teachers, including those who create their own multimedia learning media and those who adopt multimedia learning media from other sources, such as YouTube, TikTok, Instagram, or ready-to-use media. The results of this study indicate that more teachers create their own multimedia learning media than those who adopt multimedia from other sources.

3.2.1 Planning

Effective teaching begins with careful planning of learning objectives, which serves as the foundation for enhancing the quality of instruction. Teachers often design weekly or daily learning plans as a way to ensure lessons are purposeful and structured ([32]). By establishing clear objectives and aligning them with the use of learning media, students can grasp fundamental concepts more effectively and achieve the intended learning outcomes ([33]; [34]).

This study highlights that most teachers—both those who develop their own multimedia resources and those who adapt existing ones—take into account the learning objectives and the teaching context when designing multimedia-based lessons. Such alignment ensures that students' competencies grow in accordance with the planned goals. These findings are consistent with [35] argument that teachers must carefully consider both instructional needs and learning objectives when selecting multimedia. When appropriately chosen, multimedia not only strengthens students' understanding of the material but also enhances the efficiency and effectiveness of the learning process ([36]; [37]).

However, effective integration of multimedia does not depend solely on the choice of media. Teachers must also pay attention to students' readiness to engage with technology. Without adequate readiness, delivering lessons through multimedia becomes difficult, and students may struggle to comprehend the content ([38]; [39]). In early childhood education, the challenge becomes even more specific: multimedia tools must remain simple, stimulating, attractive, and encouraging so that children remain engaged and motivated in the learning process ([40]).

In general, planning learning objectives and aligning them with multimedia use are crucial steps in improving instructional quality. Clear objectives guide the choice of media, ensuring that teaching strategies are purposeful and student-centred. At the same time, teachers must remain mindful of learners' technological readiness, particularly for younger students, to ensure that multimedia use

truly enhances understanding. When these factors are carefully balanced, multimedia becomes a powerful tool for supporting effective and meaningful learning.

3.2.2 Development

From this study, it is known that the majority of teachers, both those who create their own and those who adopt multimedia learning media, have paid attention to student involvement (needs analysis and adapting to student characteristics), multimedia principles (coherence principle, redundancy principle, temporal contiguity principle, and modality principle), and instructional design in developing multimedia. This indicates that the multimedia learning media used is in accordance with student needs, allowing children to focus on the material because the media is engaging, and the learning experience becomes more enjoyable. The impact on learning is that optimal learning experiences can be achieved, where children can absorb information more easily, feel motivated, and develop holistically in a safe and enjoyable environment.

To determine the suitability of learning media development, it is necessary to analyze student characteristics so that media development adapt to the student characteristics ([41]) and academic abilities ([42]). This aligns with the study findings. If the student's education level is relatively low, then the writing of learning media must use simple and easy-to-understand language and words. Meanwhile, if students have low reading interest, learning media needs to be supplemented with interesting picture illustrations so that it can make the students motivated to read. This is important because all learning processes must be adjusted to the student characteristics ([42]).

The learning media developed must align with the student's learning style, learning themes/topics, available technological capabilities, and be accessible to students ([43]). In terms of material, the material used as a reference must refer to the curriculum used. In terms of language quality, the language used in multimedia is expected not to be standard language, so that it can motivate students and make the learning enjoyable ([44]).

Another factor that teachers must consider while developing multimedia learning media is the principle of coherence. According to this principle, the media must not only interesting but it must also have irrelevant content because it can contribute to the learning process ([45]). This is in line with the results of this study, namely that the majority of teachers, both those who create their own and those who adopt multimedia from other sources, remove foreign words, sounds, and images that are not relevant to learning objectives to increase the coherence and effectiveness of learning. Valuable learning occurs when important information is conveyed and processed into a coherent presentation ([46]).

A media (multimedia) that has been developed can be tested and its feedback can also be obtained, which is used as a reference in developing permanent media. Developmental testing is carried out on product designs targeting actual subjects. From this trial, data on responses, reactions, or comments from users is searched for. The results of the trial are used to improve the product, and after being improved, it is then tested again until effective results are obtained ([42]). Learning multimedia that contains well-packaged content has a determining impact on the success of the teaching and learning process ([47]). In this study, to obtain effective results, the majority of teachers, both those who create their own and those who adopt multimedia from other sources, present focused content in multimedia learning media so that students can receive information clearly and in a directed manner.

In this study, the learning media created or used by teachers do not contain excessive text from the narrated animation. This aligns with the principle of redundancy, namely that too much data can interfere with the learning process ([48]). The use of text in multimedia learning media for early childhood should not be used too much; therefore, teachers need to know that the best media in learning is when the media can facilitate students in their learning ([49]).

The principle of temporal contiguity refers to the presentation of relevant text and visuals simultaneously, not sequentially ([37]). This study also shows the same thing, namely that relevant text and visuals are presented simultaneously. When students see images that are relevant to the text, they build stronger connections between the concepts being taught ([50]). In addition, when information is presented visually and verbally, the recipient of the information will remember it more easily ([51]). For example, quizzes, simulations, or educational games. By utilizing educational games, students get immediate responses or results for the answers they give, and this allows students to learn anytime and anywhere because educational games are portable ([52]). Educational games can transform complex topics into easier-to-understand and remember ([53]).

The modality principle recommends that instructional visualizations (such as graphical data, still images, animations, and videos) be accompanied by audio narration rather than written text ([54]; [55]). The multimedia learning media in this study are in accordance with the modality principle, using logical and easy-to-follow information and a clear structure so that students understand the learning flow.

The communication process in class does not always run smoothly because of the differences in the memory of each student and the teacher's teaching style. These can be obstacles to the delivery of information. Learning media is an alternative when there is information that is difficult to understand, as one way of conveying messages from the sender (teacher) to the recipient (student), aiming to make the information conveyed easy to understand ([56]). Learning media helps clarify information that is still abstract, as a common perception and understanding among students. Therefore, in developing learning media, it should contain information that is logical and easy to understand ([11]).

Multimedia learning media with a clear structure helps students understand the learning flow effectively, an organized presentation makes it easier for students to follow the material, and improves long-term understanding for early childhood ([57]). Using the right strategy in developing multimedia is seen from various aspects. In terms of material, the material should be easy for students to learn, and quizzes should suit the material.

Regarding instructional design, teachers are required to create creative and innovative learning media to create a new learning experience, combining text, images, audio, music, animated images, or videos into one unit ([58]). In the multimedia learning media development stage, early childhood teachers as facilitators compile all the components such as text, images, videos, audio, and learning materials, which are adjusted to the series of sketches. The design of the multimedia display that will be developed can be seen in the series of sketches ([59]). This is in line with the results of this study, in which teachers develop multimedia learning media designs in the form of text, graphics, video, audio, and animation.

Text can be combined with other multimedia elements to increase the attractiveness and effectiveness of learning. Text is the basis for managing words and multimedia-based information. Text is formed from letters that form words containing a certain message ([60]). In accordance with this statement, paying attention to the structure of structured learning media makes it easier for students to understand and use learning media ([61]). Variations in multimedia learning media

features are adjusted to the needs of early childhood and cover a variety of student learning styles, including visual, auditory, and kinesthetic learning styles ([62]).

The advantages of using graphic-based media include being more practical when carried and used, easy to update, affordable, and students are very familiar with it. The disadvantages of using graphicbased multimedia are the boredom felt by students if they continue to use these media, and teachers also face difficulty in using multimedia ([56]). Graphics themselves have characteristics as conveying information through symbols that build students' interest in learning to explain the contents of the material, and illustrate concepts that cannot be conveyed directly ([63]). Therefore, the use of graphics in learning media can be adjusted to the needs and topics of learning.

Multimedia learning media design in the form of learning videos can be used as an effective learning resource. A video can display a real concept, show learning in a structured manner, and be developed according to the learning topic. Learning videos can also stimulate students' thoughts, feelings, and willingness to learn through the display of ideas or concepts, messages, and information in audiovisuals ([64]). For example, research conducted by [65] indicates that video-based learning media with ethical vocabulary themes such as "sorry," "please," "thank you," and "excuse me" improve children's understanding of those words. By combining musical and visual elements in the media, children can more easily remember the ethical principles conveyed ([65]).

Multimedia learning media design in the form of audio is known as sound recordings, lectures, podcasts, audiobooks, and other recorded materials. This can be in the form of music or sound effects, voiceovers that attract children's attention, making it easier for them to understand the learning provided. The advantages of audio-based media include affordable costs, which can be used in individual or group teaching, while the disadvantages of audio-based media are that if the playback is done continuously, children will get bored, the presentation is less noticeable, and feedback is difficult because there is only one way of delivery. However, the two elements above can be concluded as audiovisual media, namely a combination of video and sound recording. With the presence of audiovisuals themselves, children can see a real action from what is contained in the learning media. Children's learning motivation will be more stimulated ([64]).

Animation can be defined as a visual representation of humans, caricatures, animals, or events, both real and fictional ([56]). In the contemporary educational context, animation is considered an innovative teaching medium that effectively enhances student engagement and learning efficiency ([66]). Furthermore, it provides a valuable means of illustrating complex or abstract concepts that are often difficult to communicate through static images or text alone. When integrated with audio elements, animation supports diverse learning styles and allows students to optimize their individual learning processes ([67]). The development of animation materials, however, requires the use of specialized software. Educators may employ applications such as Macromedia Flash or Swish MX, with the choice of software largely determined by individual preferences and levels of proficiency ([68]).

3.2.3 Implementation

In this era, dependence on technology requires teachers to make changes in learning, especially in early childhood. This is done so that the learning process is not monotonous and does not seem oldfashioned. With this change also, the students will not feel bored during the learning process ([69]). One approach that is widely used is the use of multimedia because multimedia provides a studentcentered learning experience. This media not only visualizes complex concepts, but also allows students to learn independently more flexibly and adaptively, and increases student involvement during the learning process ([70]).

The results of this study indicate that the majority of teachers, both those who create their own learning multimedia and those who adopt from other sources, feel that the use of multimedia is very beneficial for students and makes the class interactive. In addition, it is in line with research conducted by [70], which shows that the use of mobile technology makes learning activities fun, interesting, and useful, and improves student achievement. The use of multimedia learning media in education has proven effective in transforming abstract concepts into concrete content. The media are such as videos, animations, and interactivity can improve students' understanding of difficult material ([71]).

Moreover, multimedia learning media can stimulate students' interest in the learning process, making students' learning experiences like those in real life around them ([72]) allowing students to directly observe complex objects, overcoming the limitations of human senses in hearing and seeing ([73]). The concrete concept can make students understand the material presented better ([74]).

3.2.4 Evaluation and feedback

Multimedia evaluation aims to determine whether the multimedia used meets the goals and provides benefits to students ([7]). This research reveals that the majority of teachers, both those who create their own and those who adopt multimedia learning media, feel the need to conduct regular evaluations to assess their effectiveness in achieving learning objectives and provide opportunities for students to give feedback on the use of the multimedia, so that the multimedia learning media presented is in accordance with the needs and interests of children.

The results of this study support the research conducted by [23] which states that the results of the evaluation can be a measure of success and identify weaknesses that arise during the process, which can be used as feedback, considerations, and guidelines for designing the next media program. The results of this study also support the research conducted by [75], who evaluate learning media based on four aspects, namely suitability to the material, student characteristics, student learning styles, and supporting facilities.

3.2.5 Maintenance and updates

The use of technology in education is a program that is implemented by facilitating learning and managing existing learning resources for students ([76]). This study revealed that the majority of teachers, both those who create their own multimedia learning media and those who adopt it, have maintained and updated their multimedia learning media management. This maintenance and updating is done by ensuring that the multimedia learning media are always contextualized to the real world and used effectively in each topic or theme in class. This demonstrates that learning is oriented towards contextual problem-solving skills. The impact on learning is that it can stimulate critical thinking and communication skills in students.

3.2.6 Training and Support

This research reveals that the majority of teachers, both those who create their own and those who adopt multimedia learning media, feel the need for adequate training to use multimedia effectively and the need for support in the form of multimedia that can be used by all parties, including students with special needs. Therefore, in line with developments in information and technology, multimedia learning media training is necessary for educators to create enjoyable learning experiences for students. The results of this study are in line with the statement of [20], who states the importance

of training for early childhood teachers on the use of technology that supports children's developmental needs.

Adequate training is essential for teachers to be able to utilize learning media effectively, because teachers as implementers in the field are required to have digital competence with optimal mastery to balance the various digital characteristics of students ([77]). This training includes an understanding of various types of media, how to integrate them into the curriculum, and strategies to optimize the use of media in the learning process ([78]). With proper training, teachers can improve their skills in designing and implementing learning media that suit students' needs, thereby improving the quality of learning ([79]).

Easily accessible multimedia in the learning process is very important for all students, including those with special needs, therefore, it is necessary to create an inclusive learning environment. The use of multimedia learning media is currently still not specifically intended for children with special needs. For children with special needs, it is better to get guidance from teachers in the form of how to use multimedia and emphasize the material. For teachers, there needs to be ongoing training to help them identify strengths and needs in teaching children with special needs ([80]) because, in delivering material to children with special needs, teachers are expected to understand the special needs of children with special needs ([81]).

Most teachers have managed multimedia learning according to its main components. However, some teachers who adopt materials from other sources believe otherwise. They argue that creating multimedia does not need to consider the objectives and learning context. They also think periodic evaluations are unnecessary to measure its effectiveness. In addition, they do not see the need to provide students with opportunities to give feedback on the use of multimedia.

In addition, there are still teachers, both who create their own and those who adopt multimedia learning media, state that there is no need to pay attention to student involvement (needs analysis and adapting to student characteristics), multimedia principles (coherence principle, redundancy principle, temporal contiguity principle, and modality principle), and instructional design in developing multimedia; there is no need to update the multimedia topics used; there is no need for training on the use of multimedia; there is no need for multimedia that can be used by all students, including students with special needs. Moreover, those teachers feel that the use of multimedia is not beneficial for students.

This condition has a negative effect on the learning process, namely, conventional learning, learning materials that are not student-centered, unattractive, and unenjoyable. This causes inadequate child development as well as ineffective and inefficient learning. To overcome this, training in managing multimedia learning media is needed.

4. Conclusion

The findings of this study reveal six key components in managing multimedia learning media in early childhood classrooms. These components include planning, development, implementation, evaluation and feedback, maintenance and updating, as well as training and support. Each component plays an essential role in ensuring that multimedia can be effectively integrated into the teaching and learning process.

In terms of multimedia planning, teachers are expected to carefully consider the objectives and the broader learning context. Effective planning ensures that the use of multimedia aligns with curriculum goals and supports children's developmental needs.

The development stage emphasizes student engagement through needs analysis and adaptation to learners' characteristics. In this stage, teachers should also apply established multimedia principles—such as coherence, redundancy, temporal contiguity, and modality—while integrating sound instructional design strategies. These considerations help ensure that multimedia materials are both pedagogically sound and accessible to young learners.

The implementation of multimedia in early childhood classrooms has proven highly beneficial. Multimedia not only supports the delivery of content but also enhances children's interest, motivation, and overall learning experiences.

Evaluation and feedback are equally important in sustaining effective multimedia use. Teachers should conduct regular assessments to measure the effectiveness of multimedia tools and provide opportunities for students to share feedback on their experiences. Such practices help refine and improve the integration of multimedia in future lessons.

Another essential aspect is maintenance and updating. Teachers, as facilitators, must ensure that multimedia content remains relevant, accurate, and in line with current classroom themes. This helps prevent outdated information from limiting the effectiveness of the learning process.

Finally, training and support are critical for long-term success. Teachers require adequate training to use multimedia effectively, as well as institutional support to ensure that multimedia resources are widely available. This includes providing access to all learners, including those with special needs, thereby fostering inclusivity in the classroom.

As a recommendation, future research could explore experimental studies to examine the application of multimedia principles—such as coherence, redundancy, temporal contiguity, and modality—in specific early childhood themes, for example, animals and their habitats. Such studies could provide deeper insights into how multimedia design principles influence learning outcomes in young children.

5. Research Implications

This research implies that the results can be used as a guide for early childhood teachers in managing multimedia learning media, encompassing planning, developing, implementing, evaluating and giving feedback, maintaining and updating, as well as training and support. Good management of multimedia learning media will streamline the learning process and can improve student learning outcomes. Furthermore, the results of this study increase the understanding of educational institutions and policymakers that teachers need training on the use of multimedia, the management of multimedia learning media, and the availability of multimedia that can be used by all students, including students with special needs.

6. Research Limitations

The limitation of this study is that this research only involved early childhood education teachers in Central Java, making the results non-generalizable. Therefore, research with a broader population is needed to generalize the results.

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