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Improving 21st Century Competencies: Implementation of Problem- and Project-Based Digital Maze Games in Early Childhood

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ABSTRAK

Kompetensi abad 21 sangat penting untuk dikembangkan. Perkembangan zaman terus terjadi, terutama padabidang teknologi dan ekonomi. Namun kenyataan di lapangan menunjukkan bahwa, 90% pemanfaatan IT dalam dunia pendidikan hanya untuk mengakses informasi dan video yang dipertontonkan kepada anak.Hal tersebut membuat komunikasi hanya berjalan satu arah dan kurang membangkitkan kemampuan berpikir kritis anak. Penelitian ini bertujuan untuk menghasilkan rancang bangun dan menganalisis vailiditas media game maze digital untuk menstimulasi keterampilan abad 21 pada anak usia 5-6 tahun. Penelitian ini termasuk dalam jenis penelitian pengembangan dengan menggunakan model ADDIE. Subjek pada penelitian ini berjumlah 30 anak dengan 2 validator ahli materi dan 2 validator ahli media. Teknik pengumpulan data menggunakan kuesioner. Data yang telah dikumpulkan kemudian dianalisis menggunakan analisis kuantitatif deskriptif. Hasil uji validitas ahli materi memperoleh skor 90% (sangat layak), uji validasi ahli media 97% (sangat layak), hasil uji coba perorangan memperoleh rata-rata total sebesar 77.5% (layak). Dapat disimpulkan bahwa, kebaruan media game maze digital layak digunakan dalam pembelajaran untuk menstimulasi keterampilan abad 21 anak usia 5-6 tahun. Implikasi penelitian ini adalah dapat menarik antusias anak dalam belajar.Dengan demikian, anak dapat memiliki kecakapan kolaborasi, literasi digital, dan meningkatkan kemampuan berpikir kritis yang mumpuni melalui pemecahan masalah untuk menemukan kosakata baru.

ABSTRACT

21st century competencies are very important to develop. Developments continue to occur over time, especially in the fields of technology and economics. However, the reality on the ground shows that 90% of IT use in education is only to access information and videos shown to children. This makes communication only go in one direction and does not stimulate children's critical thinking skills. This research aims to produce a design and analyze the validity of digital maze game media to stimulate 21st century skills in children aged 5-6 years. This research is included in the type of development research using the ADDIE model. The subjects in this study were 30 children with 2 material expert validators and 2 media expert validators. The data collection technique uses a questionnaire. The data that has been collected is then analyzed using descriptive quantitative analysis. The results of the material expert validity test obtained a score of 90% (very feasible), the media expert validation test 97% (very feasible), the results of individual trials obtained a total average of 77.5% (feasible). It can be concluded that the novelty of the digital maze game media is suitable for use in learning to stimulate the 21st century skills of children aged 5-6 years. The implication of this research is that it can attract children's enthusiasm for learning. In this way, children can have collaboration skills, digital literacy, and improve critical thinking skills through problem solving to discover new vocabulary.

1. INTRODUCTION

21st century competencies are achievements that a person must have in order to be able to take part in the 21st century. This era provides a new perspective to equip children to have global knowledge, skills in technology, media, information and life skills that are integrated in an educational cycle. This is an effort to prepare and shape children's character, so that they can compete and adapt in the future. The

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process of cultivating 21st century character requires innovative learning activities and contains high level learning outcomes (HOTS) through the application of open ended play based learning strategies. Open ended play provides opportunities for children to have the 4C skills, namely creative thinking, critical thinking, problem solving, communicating and collaborating (Rivalina, 2020; Sutama et al., 2021). Meanwhile, developmentsScience and technology have recently been very massive and rapid and have influenced all aspects of human life, including the world of early childhood education (Dewi, 2022; Anwar, 2021). Educational technology has enriched children's learning experiences with the availability of various interactive applications, as well as providing many very varied and interesting digital learning resources (Hariyadi et al., 2023; Fitri Mulyani, 2021). Therefore, the existence of science and technology should be utilized as optimally as possible by teachers in learning to foster children's digital literacy and for flexibility in learning resources. Thus, this integration is an alternative that can provide effective and interesting learning experiences for children which can help children develop digital technology skills (literacy) from an early age via devices, tablets or computers.

The positive impacts of this integration include improving the quality of learning, facilitating access to find learning references that can support children's learning, developing children's creativity through web development.as well as interactive games, and as a means to facilitate communication (Monalia et al., 2022; Syahroni, 2020). Based on this review of opinions, it can be concluded that teachers should integrate science and technology in learning. Teachers must also be able to design so that children are actively involved during the learning process. Because success in learning will be reflected inthe quality of children's interactions with teachers and teaching materials, pedagogical abilities in planning learning including content adapted to the curriculum used, as well as the implications of the learning process for children's developmental achievements.

Educators are required to have knowledge about technology and implement it in the learning process. 21st century teachers must master knowledge called TPACK or technological, pedagogical, and content knowledge (Handini & Mustofa, 2022; Ajizah & Huda, 2020). TPACK is a framework that can be used to analyze teacher knowledge related to the integration of technology in the learning process (Maharani et al., 2022; Nurfidah, 2021). Technological knowledge (TK) or what is called technological knowledge is knowledge about various types of technology as tools, processes and resources. However, the results of observations in the field, namely at Siti Hajar Integrated Early Childhood Education and Elbaith Rif'a Islamic Happy School Kindergarten, show that the available mazes are still made from paper and wood. The maze will tear easily if exposed to water, peel, catch fire easily if made of wood, break easily if maintained poorly, and is not based on problem solving. This situation reflects the inefficiency of learning media because apart from being easily damaged, this traditional maze media can only be applied at school. However, when they are at home, children also need a learning process through playing accompanied by their parents. If this situation is allowed to continue, it is feared that children's critical thinking abilities will not develop.

Displaying videos or content without significant interaction will only provide a one-way and monotonous experience for children. Therefore, to create meaningful learning, it is necessary to involve children in the process of problem solving and decision making. Learning must be designed in such a way that children can actively participate, solve problems, and take action based on the choices they make. This will not only make the learning experience more interesting, but will also increase the effectiveness of the child's learning process. This kind of action is included in cognitive development efforts to sharpen children's thinking abilities (Pahenra, 2021; Tatminingsih, 2019). Cognitive abilities are classified into two, namely, scientific cognitive development and concept cognitive development in the form of understanding patterns, shapes, number concepts, number symbols and letters (Rosmauli & Watini, 2022; Aisyah, 2020). There are several levels of achievement of problem solving abilities for children aged 5-6 years, including being able to recognize each symbol of a number, being able to show various objects in various forms of pictures or writing, being able to solve simple problems that occur in their daily lives, and being able to solve problems in a creative way (Anggara, 2019; Paramita et al., 2019). Based on the problems above, the solution that can be done is to create maze game media which is packaged in the form of an application. This game media needs to be developed so that children have basic digital literacy and critical thinking through the challenges that must be solved in the game. The digital maze game developed in this research is a migration from a game that initially only found one way out (in problem solving) to multi-way. Digital maze games are considered to be able to improve children's critical thinking skills, stimulate problem-solving abilities, find creative, innovative, unique ideas, and in the future can be useful for children to face competition in the global era.

The research results show that interactive games are proven to improve the quality and learning outcomes (Faradisha & Ambara, 2022; Dewi & Agung, 2021). This happens because interactive games can make learning more fun and can provide an understanding of abstract concepts that become more concrete through animated visualization (Aryani & Ambara, 2021; Kurnia, 2020). Science and technology can have a

positive impact in the field of education, as is the case with Early Childhood Education. Thus, it can be concluded that this digital maze game has comprehensive benefits for children's development. Some of the benefits of digital mazes include, firstly, from a cognitive perspective, children can learn about concepts, are able to develop children's analytical logical thinking skills, and stimulate problem-solving abilities. Second, in terms of language, it is demonstrated by the child's ability to argue about problems that occur and their solutions. Third, from a social-emotional perspective, it can train patience, thoroughness, responsibility, increase children's self-confidence because they are able to achieve the expected goals, and build collaboration with peers to create projects. Fourth, in terms of physical motor skills, it can train eye and hand coordination, it can direct children to achieve a high level of physical motor development through children's original actions to create products. Fifth, in terms of art, train children's creativity and innovation to find various solutions and create various unique works. Lastly, in terms of religious and moral values, children will learn to build good communication with friends, share and tolerate each other.

Several previous studies have revealed that the use of mazes in early childhood learning has proven to be effective in early childhood learning (Faizah et al., 2023; Ramadhani et al., 2021). Other research reveals that maze game media has been proven to stimulate children's physical motor skills in an easy and fun way (Anggraeni & Na'imah, 2022; Munawaroh & Wijayanti, 2019). Based on the results of previous research, it is known that the maze game media has a positive influence on stimulating children's cognitive, affective and psychomotor development so that this media is very suitable to be applied in learning. However, there has been no research regarding digital-based maze media designed with problem-solving and project-based play concepts to develop children's 21st century skills.

This research aims to produce a design and analyze the validity of digital maze game media to stimulate 21st century skills in children aged 5-6 years. It is hoped that the results of this research will be able to facilitate early childhood learning and improve 21st century skills as a process of self-development. The focus of this research is the development of digital maze media that can be accessed on PC, tablet, iPad, iOS and Android to optimize children's 21st century skills (critical thinking, creativity, communication and collaboration). The implication of this research is that it can attract children's enthusiasm for learning. In this way, children can have collaboration skills, digital literacy, and improve critical thinking skills through problem solving to discover new vocabulary.

2. METHOD

This research uses a development method (research and development) with the ADDIE approach model. The reason for choosing this model is because the ADDIE model has a research flow that is simpler, more complete and easier to understand, so using the ADDIE model is suitable for developing game media. There are 5 procedures in the ADDIE model including the needs analysis stage, design, development, implementation and evaluation. The subjects involved in this research were two material experts, two design experts. Meanwhile, user subjects were determined using a total sample technique involving 20 group B children from Siti Hajar integrated Early Childhood Education and 10 group B children from Elbaith Rif'a Islamic Happy School Kindergarten, so the total number of research subjects was 30 children. The data collection technique used is a questionnaire given to experts to obtain data on the feasibility of research and development products. Meanwhile, to determine the child's ability to play games, the researcher filled out the questionnaire himself. This questionnaire was used to obtain data regarding the feasibility of the maze media being developed. The data that has been collected is then analyzed using descriptive quantitative to obtain measurable data accompanied by a straightforward explanation of the data. The grid for collecting data from validators and trials on children aged 5-6 years and conversion of achievement levels to a scale of 5 can be presented in Table 1, Table 2, Table 3, and Table 4.

Table 1. The Media Expert Instrument Grid

No.	Aspect	Indicator	Item Number	Number of Questions
1	Attractiveness	1. Appropriateness of the composition of the use of design colors	1	9
		2. Suitability of layout or layout	2	
		3. Suitability of space or space	3	
		4. The font size is appropriate for AUD	4	
		5. Voice clarity	5	
		6. Sounds right for AUD	6	
		7. Elemental attractiveness for AUD	7	

		8. Image accuracy for AUD	8	
		9. Attractive color composition	9	
2	Convenience	1. There are instructions and steps for use	10	3
		2. Ease of access	11	
		3. The game is easy to understand and play AUD	12	

Source :Suarthama (2016)with modifications

Table 2. The Material Expert Instrument Grid

No	Aspect		Indicator	Item Number	Number of Questions
1	Effectiveness	1.	Suitability to learning objectives	1	4
		2.	Can foster children's curiosity	5	
		3.	Can maximize the child's full potential	2	
2	Suitability	1.	Suitable for the child's age level	3,4	2
3	Attractiveness	1.	Interesting topic raised	6	4
		2.	Easy for children to understand	7	

Source :Suarthama (2016)with modifications

Table 3. The Instrument Grid for Testing Children Aged 5-6 Years

No	Aspect		Indicator	Item Number	Number of Questions
1	Enthusiasm	1.	Active during play	1	4
		2.	Be enthusiastic while playing the game	2	
		3.	Quick response while playing the game	3	
		4.	Respond well	4	
2	Interest	5.	Child focus	5	4
		6.	Ability to explore letters	6	
		7.	How long to play	7	
		8.	Duration to complete the game	8	
3	Creativity	9.	Wayfinding ability	9	4
		10.	Children's curiosity	10	
		11.	Children's independence	11	
		12.	Ability to express opinions	12	
4	Critical thinking	13.	Ability to avoid traps	13	4
		14.	Ability to complete levels	14	
		15.	Ability to refute answers	15	
		16.	Ability to draw conclusions about the benefits of games	16	

Source :Juannita & Mahyuddin (2022)with modifications

Table 4. The Conversion of Achievement Levels to A Scale Of 5

No.	Validity Criteria	Qualification
1.	0-20%	Not really worth it
2.	21%-40%	Not feasible
3.	41-60%	Not worth it
4.	61-80%	Worthy
5.	81-100%	Very worthy

Source :Tegeh et al., (2014)with modifications

3. RESULT AND DISCUSSION

Result

The results of this research will discuss two things in general, namelydesign and validity of the maze game. This game media concept was developed using the ADDIE model which consists of 5 stages, namely needs analysis, design, development, implementation and evaluation. This validity was used to determine the feasibility of the maze game carried out by early childhood material experts, children's game media experts, and children aged 5-6 years from two institutions. In the first stage of needs analysis,

researchers conduct collegial discussions to agree on the theme of a problem. Findings in the field show that the use of information technology in the Early Childhood Education environment has tended to be unidirectional and monotonous. This can be seen from the use of IT which is limited to accessing news and watching videos, without involving children in active interaction with this technology. Therefore, it is necessary to develop game media that is specifically designed so that children can interact with IT. The digital maze in this research is designed to be problem-based and there is a follow-up project for children to overcome these problems with the aim of providing a more interactive learning experience, stimulating creativity and developing children's skills while still considering relevant educational values.

The second stage is design, at this stage the researcher develops a design (design/planning) or blue print regarding the digital maze. Design includes story board planning, navigation structure design, flowchart view planning, state transition diagram design, and user interface design. This story board will be used as a guide for developing the product. The third stage is development, at this stage the researcher creates a product based on the story board that has been prepared. At this stage the researcher also tried to look for references to animation and transitions to support the attractiveness of the media. Then the elements contained in the media are selected, such as determining color, contrast, images, animation, font type, font size and audio used. The digital maze game design images that have been created can be presented at Figure 1.

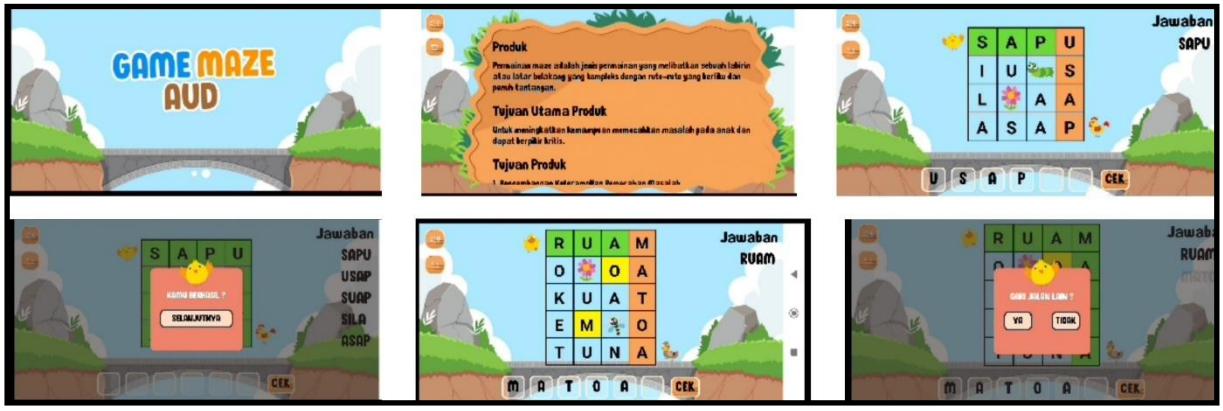

Figure 1. The Design Games Digital Maze

The fourth stage is implementation, at this stage the researcher asked for validation from two material expert lecturers and two media expert lecturers. This validation is useful for getting feedback in terms of the suitability and meaningfulness of the content according to material experts as well as feedback regarding the attractiveness and efficiency of the media according to design experts. After being declared feasible without revision, the researchers continued the trial directly with group B children, namely 20 children from the Siti Hajar integrated Early Childhood Education and 10 children from the Elbaith Rif'a Islamic Happy School Early Childhood Education. The fifth stage is evaluation which plays a role in assessing the success or suitability of developing digital maze media. Evaluation aims to improve the product by utilizing feedback from experts obtained through learning material expert testing, learning design expert testing, and group B child testing. The evaluation process not only takes place at the final stage of development, but is also integrated in each stage of the model. ADDIE development. Evaluation results include development validity *games* digital maze based on assessments by learning content experts, learning design experts, learning media experts, and the results of product trials with children's participation. In summary, the results of product validation and trials can be presented in Table 5.

Table 5. The Percentage of Product Validation and Trial Results

No.	Subject	Results (%)	Qualification
1.	Material expert validation	90%	Very worthy
2.	Media expert validation	97%	Very worthy
3.	Individual trials:		
	a. Aspects of children's enthusiasm	77.5%	Worthy
	b. Aspects of children's interests	81%	Very worthy
	c. Aspects of children's creativity	67.5%	Worthy
	d. Aspects of children's critical thinking	76%	Worthy

Based on the data in the table above, it can be seen that the material expert validation results obtained a percentage of 90%, including the very feasible category. Meanwhile, the media expert validation results showed that the results were 97%, including the very feasible category. The results of individual trials were specified into several aspects, including the child's enthusiasm aspect which received a score of 77.5%, which was included in the decent category, the child's interest aspect which received a score of 81%, which was included in the very feasible category, the child's creativity aspect which received a score of 67.5%, which was included in the appropriate category, and the aspect The child's critical thinking score was 76%, including in the decent category.

Discussion

Based on the research results, it can be seen that this digital maze media is very interesting and very suitable for application to group B children. This media is effectively used to develop 21st century skills, namely critical thinking, creativity, collaboration and communication. The importance of 21st century competencies in child development cannot be ignored. In the era of globalization and technological advances, children need to be equipped with skills that can help children succeed in various aspects of life. 21st century skills can provide provisions for children to grow and be able to compete in the future. This is in line with previous research which revealed that 21st century competencies provide a strong foundation for children's growth and success in the future to grow a prosperous and dignified nation (Sutama et al., 2022; Maylitha et al., 2022). There are several factors that influence the success of this media development. The first factor, digital maze media is very suitable for developing high-level thinking skills for children because this media allows children to understand patterns and relationships between various elements in the game. This helps children develop logical thinking and reasoning skills as well as problem solving because they have to figure out the best way to find a word in the game based on the existing information and clues. This statement is in accordance with the opinion which states that when children are faced with situations that encourage children to solve problems and foster curiosity, the child's thinking skills will become more complex (Ndari et al., 2019; Wirasasmita & Putra, 2018). Games the digital maze that has been developed is also able to provide opportunities for children to communicate about finding a way out to combine various letters into an integrated word in a way that the child himself wants. Possession of communication skills is considered very important to develop, because it allows children to convey unique ideas, collaborate with others, solve problems, and understand different perspectives (Hayati & Na'imah, 2022; Fitri & Pransiska, 2020).

The Second**,** This digital maze media can attract attention and foster children's enthusiasm for learning while playing. This is because this digital maze media is equipped with animations for children, eye-catching colors, clear audio, and a choice of letters that are simple and easily recognized by children. The criteria for media that can attract children's attention is media that is equipped with writing, audio, color and funny animations or does not tend to be awkward when used in kindergarten. Apart from adding to the aesthetics of the media, children's interest in playing with the media will influence the child's emotional state so that children will more easily understand the material with the help of image visualization. Early childhood children tend to have the characteristics of getting bored easily and having difficulty focusing in the learning process, so the use of media that can increase students' active role is really needed to support the success of the learning process (Wulandari et al., 2022; Kore et al., 2020).

The Third**,** The efficiency of this digital maze media is very easy and practical to use anywhere and with any device starting from laptops, tablets, iPads, iOS, and Android. The media is also equipped with instructions and steps for use that make it easier for teachers and parents who accompany children so that children will be better helped to understand the game concept in this digital maze game. The results obtained in this research are in line with previous research which reveals that the maze game media is very practical to use and can increase the effectiveness of learning in early childhood (Suryana et al., 2023; Ramadhani et al., 2021). Other research also reveals that the use of media in early childhood learning has been proven to be able to improve children's logical thinking, understand number symbols, count lots of numbers, remember the differences in various shapes and sizes, from small to large, and solve existing puzzles (Faizah et al., 2023; Salwa et al., 2023).

Based on the analysis of research results and supported by previous research, it can be seen that digital maze media has validity that is very feasible to be developed and applied in learning for children aged 5-6 years.The novelty of digital maze media was also stated to be very interesting and very suitable for application to group B children to develop the skills needed in the 21st century, namely critical thinking, creativity, collaboration and communication. The implication of this research is that digital maze game media can attract children's enthusiasm for learning, have collaboration skills, digital literacy, and can have strong critical thinking skills through problem solving to discover new vocabulary. The limitation of this

research lies in the limited number of subjects, so that further research can determine a wider range of subjects.

4. CONCLUSION

The validity test results of material experts received very good qualifications, learning media experts received very good qualifications, and the results of individual trials received good qualifications. Based on these results, it is stated that the novel problem and project-based digital maze game media are worthy of being applied in the learning of children aged 5–6 years, considering their usefulness in supporting the achievement of qualified 21st-century skills. This result was obtained because the digital maze game media design and media development were in accordance with ADDIE procedures, so optimal results were obtained.

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