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HTML-Based Interactive Crossword Puzzles for Science Learning Content in Elementary School

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ABSTRAK

Kurang maksimalnya pemanfaatan teknologi dalam pelaksanaan pembelajaran berdampak pada media pembelajaran menjadi kurang interaktif dan kurang variatif. Penelitian ini bertujuan untuk mengembangkan media teka-teki silang interaktif berbasis HTML khususnya muatan IPA tema 6 subtema 1 kelas V. Penelitian ini termasuk jenis pengembangan dengan menggunakan model ADDIE dan pelaksanaannya terbatas hanya sampai tahap pengembangan saja. Subjek pada penelitian ini yaitu media pembelajaran teka-teki silang interaktif. Metode dan instrumen pengumpulan data yang digunakan yaitu angket. Analisis deskriptif kuantitaif dan kualitatif digunakan sebagai teknik analisis data. Hasil penelitian menunjukkan bahwa validitas media teka-teki silang interaktif oleh ahli materi dengan kualifikasi sangat baik. Hasil kepraktisan media teka-teki silang oleh guru memperoleh kriteria praktis, siswa perorangan memperoleh kriteria praktis, dan kelompok kecil siswa memperoleh kriteria praktis. Dengan demikian, media pembelajaran dengan kebaruan berupa teka-teki silang interaktif berbasis HTML pada muatan IPA tema 6 subtema 1 kelas V layak dan praktis untuk digunakan. Implikasi penelitian ini adalah dapat dijadikan sebagai salah satu opsi media pembelajaran interaktif yang memanfaatkan teknologi di sekolah guna meningkatkan, sekaligus mengetahui pemahaman siswa atas materi yang telah diberikan.

ABSTRACT

The less-than-optimal use of technology in implementing learning impacts learning media becoming less interactive and less varied. This research aims to develop HTML-based interactive crossword media, especially science content theme 6 subtheme 1 class V. This research includes a type of development using the ADDIE model, and its implementation is limited to the development stage only. The subject of this research is interactive crossword puzzle learning media. The data collection method and instrument used was a questionnaire. Quantitative and qualitative descriptive analysis is used as a data analysis technique. The research results show that the validity of interactive crossword puzzles by qualified material experts is very good. The results of the practicality of crossword puzzle media by teachers obtained practical criteria, individual students obtained practical criteria, and small groups of students obtained practical criteria. Thus, the novel learning media in the form of HTML-based interactive crossword puzzles on science content theme 6 subtheme 1 class V is feasible and practical. This research implies that it can be used as an interactive learning media option that utilizes technology in schools to improve and determine students' understanding of the material provided.

1. INTRODUCTION

The COVID-19 pandemic has caused the use of technology in education to accelerate as education shifts to distance learning to maintain safety. Digital technology in education is a physical contribution of technology as a learning tool and a multidimensional concept. Technology in education is the study and practice that facilitates learning and improves performance by creating, using, and managing processes and resources. It is hoped that technology can solve problems of access, quality, and social justice in education (Anggreni & Suniasih, 2021; Gunawan, 2020). This statement aligns with the demands of 21st-century learning, including using technology. 21st-century learning applies learning and innovation skills, knowledge skills, media, and technology or digital literacy. 21st-century student skills include critical thinking, communication, collaboration, and creativity. The competency learning approach for 21st-century students incorporates ICT into learning content (Syarifuddin & Nurmi, 2022; Yulianti & Wulandari, 2021).

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Technology in education can be utilized. One of the ways to do this is through the use of technology-based learning media. Media in the learning process can be interpreted as all forms of physical communication equipment, such as software and devices, that must be created or developed, used, and managed for learning needs to achieve effectiveness and efficiency (Isman et al., 2022; Okra & Novera, 2019).

The development of science and technology is increasingly encouraging reform efforts to use technological results in the learning process. Technology-based learning media is very important to support student learning success. Digital technology itself includes technology that no longer uses human or manual power. Digital technology is a complex and flexible method fundamental to human life. Digital is a concept of understanding the development of the times, from manual to automatic, from everything complicated to being concise. Digital media utilizes computers to combine text, graphics, audio, and moving images (video and animation) into a single unit, with appropriate links and tools that enable multimedia users to navigate, interact, create, and communicate (interactive). By utilizing it as a digital learning medium, teachers can convey information that is difficult to convey directly to students and create new learning experiences (Sari & Ahmad, 2021; Wijaya et al., 2021; Garini et al., 2020). Digital learning is very necessary in lessons, especially in lessons that are considered difficult.

Natural Sciences (IPA) is a lesson that students consider difficult. Most students from elementary school to middle school consider science subjects difficult. The Ministry of National Education's report also supports this, stating that the Final Semester Examination results from implementing science lessons still needed to be revised (Mukhlis, 2021; Satriaman et al., 2018). In science learning in elementary schools, there is factual and concrete material. However, some material concepts are abstract and cannot be explained concretely, making them more difficult for students to understand. In the sub-material, heat transfer is one of the materials that cannot be seen directly, so many students still need help distinguishing between heat transfer and heat transfer media. Previous research stated that, when learning heat material, students only received verbal explanations from the teacher without using media, and students needed help understanding the material explained by the teacher. However, suppose you use various media such as visual media in the form of pictures, audio-visual media in video presentations of heat material, concrete media, and laptops and LCD projectors. In that case, students will experience direct learning and understand the material given by the teacher more easily (Jannah, 2020; Lelita & Zuhdi, 2020).

This is supported by facts that occur in the field. Based on interviews and observations conducted at the Gugus III elementary school in Bangli District, it is known that there are still schools that need to utilize technology as a learning medium. Teachers only use conventional teaching aids with learning resources from books obtained at school due to the lack of technological facilities owned by the school and the teacher's lack of ability and understanding in using technology as a learning medium. Was also found by previous researchers that there are schools that still use printed teaching materials as learning resources used by teachers in the learning process. Besides, teachers use only conventional media because they need more ability to develop digital learning media such as presentations, videos, animations, or interactive multimedia (Dwiqi, Sudatha, & Sukmana, 2020; Jannah, 2020). Based on interviews conducted at the Gugus III elementary school in Bangli District regarding students' character in class, it is known that students will be more enthusiastic in participating in learning if they provide material in class using facilities or media that utilize technology such as laptops and LCD projectors. However, some teachers are no longer young and rarely use these facilities because they still need help preparing them for class.

Based on the problems that have been found related to the use of technology as a learning medium and also in science learning, the heat transfer sub-material, this problem needs to be addressed because it can hurt students and teachers. Therefore, the solution offered is developing learning media on science material and sub-material on heat transfer, which is given in fifth grade, Theme 6, Sub-theme 1. With this development, it is hoped that it will also be useful for students and teachers, especially in increasing students' motivation and interest in learning and making classroom learning more active.

Education is important in human life (Dewi & Putra, 2018; Pratama et al., 2018; Wijaya, et al., 2018). All aspects of life must be connected to technological developments, especially in education. Therefore, technology is needed in education, namely in the learning process. So, the media developed as a complementary tool during the learning process in this research by utilizing an interactive crossword game based on Hypertext Markup Language (HTML). This is supported by previous research that states that using ICT-based learning media can improve student learning outcomes (Sutisna et al., 2020; Harliawan, 2015). Apart from that, research on the influence of crossword puzzles also showed that the use of crossword puzzles affected student learning outcomes, increasing student learning outcomes (Mariana, 2022; Wahyuningsih, 2021). Using HTML-based interactive crossword games as a learning medium is a new and fun learning tool that allows the class to be more active and has a good impact on increasing students' motivation and interest in learning. Crosswords can be used as a learning medium or a means of evaluation, assessed for usefulness, functionality, efficiency, and maintenance. Apart from that, crossword puzzles are

suitable as an alternative learning medium to increase students' enthusiasm for participating in learning because they get a good response. Then, using crossword puzzles as a problem assignment can also increase student learning motivation and improve student learning achievement. The development of interactive crossword puzzle learning media in this research can provide students with a new and enjoyable learning experience because students use several features to solve several questions. This crossword puzzle learning media is very interactive. Interactive is two-way communication between humans as product users and computers in the form of applications or products in certain files. Hypertext Markup Language (HTML) is a file used in this development research, which students can later access offline and online while learning occurs. HTML is a markup language that creates a network page displaying information in hypertext format (Astuti et al., 2021; Lelita & Zuhdi, 2020; Solichin, 2017; Wirani, 2018).

Based on these facts, using interactive crossword puzzles can overcome existing problems. This research aims to develop HTML-based interactive crossword media, especially science content theme 6 subtheme 1 for fifth grade. It is hoped that the new HTML-based interactive features in crossword media will increase student motivation. It is also hoped that the media created can help increase students' interest in learning and assist teachers in conveying knowledge to students.

2. METHOD

This research is included in the development type using the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The first stage analyzes student needs, curriculum, and characteristics. The second stage is designing HTML-based interactive crossword learning media based on reviewing learning materials, learning objectives, basic competencies, and indicators. This interactive crossword puzzle learning media was designed using software called Eclipse Crossword. The third stage is development, which determines the validity and practicality of the media. The fourth stage is implementation, which was not carried out due to a lack of supporting facilities and limited time and energy. The fifth stage is an evaluation to determine the quality of the media being developed and the extent to which the learning media has been achieved. Product trials are used as a basis for determining the level of feasibility and practicality of the product produced. The test subject at this stage is HTML-based interactive crossword learning media on science content theme 6 subtheme 1 fifth grade. Meanwhile, the object of testing in this research is the validity of the media carried out by experts/lecturers and the practicality of the media carried out by practitioners/teachers and students. The data collection methods used in this research were observation, interviews, and questionnaires. The data collection instrument uses a questionnaire sheet to obtain data related to the validity of the content and practicality of the product being developed. The grid of the research instruments is presented in Table 1, Table 2, and Table 3.

Table 1. Subject Expert Validity Instrument Grid

No	Aspect	Indicator	Item Number		Total Item
			Positive	Negative	
1	Material	Benefits of material for students.	5,6	-	2
		Suitability to student learning.	3	4	2
		Material accuracy.	1,2	-	2
2	Media	Ease of use.	8,9	10	3
		Compliance with instructions.	7	-	1
3	Evaluation	Provide feedback on student evaluation results.	15	-	1
		Attractiveness evaluation.	11	-	1
		Clarity of question preparation.	12,13	14	3
Total					**15**

Source: Suarthama (2016) with modification

Table 2. Teacher and Student Practicality Instrument Grid

No	Aspect	Indicator	Item Number		Total Item
			Positive	Negative	
1	Media	Ease of use.	5,6	7	3
		Compliance with instructions.	4	-	1
2	Evaluation	Provide feedback on student evaluation results.	8	-	1
		Clarity of question preparation.	9,10	11	3
3	Material	Material accuracy.	1,2	3	3
4	Function	Product use.	13,14	12	3
Total					**14**

Source: Alfiansyah (2019) with modification

Table 3. Grid of Science Content Crossword Puzzles Theme 6 Subtheme 1 for Fifth Grade

Question Indicator		Question Number
3.6.1	Stated energy sources: students can analyze the name of the energy source in question.	1
3.6.2	Given statements regarding heat energy sources and their use, students can analyze plant processes that require sunlight.	2
3.6.3	Given illustrations of differences in environmental conditions, students can analyze objects to measure the degree of heat (temperature).	3
3.6.4	Given an illustration of heat transfer in chicken farming, students can analyze the type of heat (heat) transfer that occurs.	4
3.6.5	Given an illustration of the characteristics of heat transfer, students can analyze this type of heat (heat) transfer.	5
3.6.6	Given an illustration of moving books in a relay that is likened to a heat (heat) transfer event, students can analyze this type of heat (heat) transfer.	6
3.6.7	Given illustrations of grouping objects, students can analyze the properties of these objects.	7
3.6.8	Given a statement regarding the characteristics of an object, students can analyze the properties of the object.	8
3.6.9	Stated an object's characteristics, students can analyze the object's name.	9
3.6.10	Given an illustration of making a cake using an oven, students can analyze the objects that block heat.	10

Furthermore, the data analysis methods and techniques used in this development research are qualitative descriptive statistical data analysis techniques and quantitative descriptive statistics. The qualitative analysis method processes the information obtained and groups it in words such as assumptions, criticism, suggestions, and comments provided by expert lecturers, teachers, and students. The results of the analysis are then used to improve the product being worked on. Meanwhile, quantitative analysis methods are used to analyze data in the form of numbers and use statistical techniques. This analysis is used to calculate the validity and practicality of the media.

3. RESULT AND DISCUSSION

Result

The product produced through this development research is HTML-based interactive crossword learning media on science content, heat transfer sub-material in theme 6, sub-theme 1, fifth grade. The crossword puzzle developed is an HTML file and can be accessed via laptop or smartphone devices with or without an internet network. This makes it easier to use. Besides that, it can also be made without using an internet network. Next, the resulting learning media undergo a validity and practicality testing stage. The research results are presented in Table 4, Table 5, Table 6, and Table 7.

Table 4. Results of Material Expert Product Validity Analysis

No	Statement	Overall Score
1	The evaluation material is based on basic competencies.	8
2	The material for the evaluation has been prepared according to the indicators.	8
3	The material in the evaluation is given according to the student's learning level.	8
4	The material in the evaluation does not match what was given during the lesson.	7
5	The evaluation instrument developed can help students remember the material they have learned.	7
6	The questions on the evaluation instrument are related to everyday life so they are useful for students.	8
7	The instructions on the evaluation instrument are clear and easy to understand.	8
8	Teachers and students can easily access the evaluation instruments developed.	8
9	The evaluation instrument developed is easy to use.	7
10	The features of the developed evaluation instrument still need to be improved.	8
11	The evaluation instruments developed are interesting and provide new experiences for students.	8

No	Statement	Overall Score
12	Use of language that does not give rise to multiple interpretations.	8
13	The language and sentences in the questions are easy to understand.	7
14	The language and sentences in the questions could be clearer.	7
15	Students receive feedback after completing the evaluation, and this can motivate them.	7
Total Score		**114**
Total Maximum Score		**120**
Total Percentage (%)		**95**

Table 5. Results of Practicality Test Analysis by Teachers

No	Statement	Overal Score
1	The material in the evaluation is by the Basic Competencies.	21
2	The material for the evaluation has been prepared according to the indicators.	22
3	The material in the evaluation does not match what was obtained during the lesson.	21
4	The instructions on the evaluation instrument are clear and easy to understand.	23
5	The evaluation instrument developed is easy to use.	22
6	Teachers and students can easily access the evaluation instruments developed.	21
7	The features of the developed evaluation instrument still need to be improved.	18
8	Students receive feedback after completing the evaluation, which can increase student interest in learning.	20
9	Use of language that does not give rise to multiple interpretations.	20
10	The language and sentences in the questions are easy to understand.	22
11	The language and sentences in the questions could be clearer.	18
12	The evaluation instrument developed is not suitable for use in the learning process.	18
13	The evaluation instrument model in the form of an interactive crossword puzzle can be used to evaluate other materials.	20
14	The evaluation instruments developed are not only for evaluation but can also be used as learning media.	20
Total Score		**286**
Total Maximum Score		**336**
Total Percentage (%)		**85.1**

Table 6. Results of Individual Student Practicality Test Analysis

No	Statement	Overall Score
1	The evaluation material is based on basic competencies.	55
2	The indicators have prepared the evaluation material.	54
3	The material on the evaluation does not match what was obtained during learning.	58
4	The instructions on the evaluation instrument are clear and easy to understand.	66
5	The developed evaluation instrument is easy to use.	59
6	Teachers and students can easily access the developed evaluation instruments.	60
7	Features of the developed evaluation instrument still need to be made easier to use.	56
8	Students get feedback after completing the evaluation, and this can increase students' interest in learning.	61
9	Use of language that does not cause multiple interpretations.	59
10	The language and sentences in the questions are easy to understand.	63
11	The language and sentences on the questions could be clearer.	60
12	The evaluation instrument developed is not suitable for use in the learning process.	58
13	The evaluation instrument model, in the form of interactive crossword puzzles, can be used to evaluate other materials.	53
14	The evaluation instrument developed is not only for evaluation but can also be used as learning media.	60
Total Score		**822**
Total Maximum Score		**1008**
Total Percentage (%)		**81.5**

Table 7. Analysis Results of Small Group Student Practicality Test

No	Statement	Overall Score
1	The evaluation material is based on basic competencies.	55
2	The indicators have prepared the evaluation material.	57
3	The material on the evaluation is different from what was obtained during learning.	60
4	The instructions on the evaluation instrument are clear and easy to understand.	63
5	The developed evaluation instrument is easy to use.	64
6	Teachers and students can easily access the developed evaluation instruments.	56
7	Features of the developed evaluation instrument still need to be made easier to use.	60
8	Students get feedback after completing the evaluation, which can increase their interest in learning.	64
9	Use of language that does not cause multiple interpretations.	55
10	The language and sentences in the questions are easy to understand.	62
11	The language and sentences on the questions could be clearer.	59
12	The evaluation instrument developed is not suitable for use in the learning process.	56
13	The evaluation instrument model in the form of interactive crossword puzzles can be used to evaluate other materials.	56
14	The evaluation instrument developed is not only for evaluation but can also be used as learning media.	61
Total Score		**828**
Total Maximum Score		**1008**
Total Percentage (%)		**82.1**

Based on the results of validity tests from learning material experts, the Percentage was 95% with very good qualifications. From these results, it can be concluded that the media is declared valid for learning. For the teacher's practicality test, the Percentage was 85.1 with practical criteria. The practicality test by individual students obtained 81.5% with practical criteria. Meanwhile, the practical test by small group students obtained a percentage of 82% with practical criteria. This indicates that the media developed is practically used in the learning process.

Discussion

This development research produces valid and practical HTML-based interactive crossword learning media with science content theme 6 subtheme 1 fifth grade. The results of this research align with previous research, which found that interactive crossword puzzle learning media is valid and effective for use in learning activities because it can increase students' interest in learning and train students' active learning (Pratiwi, 2022; Salsabela & Kuntjoro, 2022). Several things cause HTML-based interactive crossword learning media containing science theme 6 sub-theme 1 fifth grade to be valid and practical for the learning process. First, developing HTML-based interactive crossword media with heat transfer material has complete material coverage. This is because the material used in learning media is prepared based on the curriculum used in schools by adapting to the learning material obtained by students. Apart from that, the material used focuses more on phenomena in everyday life, so it is useful for students. This is in line with the opinion of previous research, which states that a question or question is declared valid if the manuscript's content covers the entire subject matter (Arisansi, 2020; Krisnawati et al., 2021).

Second, the media developed is easy for students to use. This is because the media is interactive and contains instructions for use. Therefore, users can prepare themselves before working on interactive crossword puzzles and know how to use the existing features. The ease of use is also considered very good because the existing features and access to this interactive crossword puzzle are designed to be a new learning media option, but they are easy for many people. This is also the basis for determining whether developing interactive crossword puzzle learning media is practical. This is in line with previous research, which states that the practicality of a product refers to the condition of the product being developed regarding its easy use so that it can be interesting, meaningful, enjoyable, and useful (Utami & Abdullah, 2020; Haviz, 2016).

Third, the media developed has the attractiveness of evaluation, clarity in the preparation of questions, and providing feedback on student evaluation results. The attractiveness of the evaluation received a very good assessment because there still needs to be more development of interactive crossword

puzzle learning media, especially in the science content of the heat transfer sub-material in the fifth grade of elementary school. On the other hand, the clarity of the preparation of the questions also received a very good assessment because the questions prepared had taken into account the rules for preparing the questions, the use of open sentences, and the choice of clear words so as not to cause mistakes.

This is in line with the previous statement, which states that good question preparation is the preparation of questions that pay attention to the use of open sentence terms, the question formulation is made clearly and correctly, avoids negative statements, and minimizes statements that give rise to double interpretations (Lusiani, 2022; Okra & Novera, 2019). The available feedback also really helps the teacher's assessment process. After the student has completed the interactive crossword learning media, the results of the student's work will appear in the form of statements regarding the correct answer, existing errors, or answers that still need to be completed. In this way, students will know how much they understand and where their mistakes are so that the teacher can explain material they have not understood.

Finally, the learning media created has the functional aspects of the learning media being developed. The assessment results show that the interactive crossword learning media is included in the practical category. This is because the media can be used in other materials, so you only need to develop the questions, but it still functions as a learning medium. This is in line with the results of previous research, which stated that a good measuring instrument is a measuring instrument that is relevant to the purpose of the measurement, namely measuring what is intended to be measured (Lusiani, 2022; Cahyadi, 2020).

Based on the results of the research that has been carried out, it is known that research into the development of HTML-based interactive crossword learning media on science content theme 6 sub-theme 1 for fifth grade at SD Negeri Gugus III, Bangli District, was considered successful. The development of interactive crossword puzzle learning media is an innovation that can be used in implementing learning, especially science content Theme 6 Subtheme 1 in fifth grade, to make it more varied. The development of crossword puzzle learning media can be used as an interactive learning media option that utilizes technology in schools to improve and determine students' understanding of the material that has been provided.

Developing interactive crossword puzzle learning media can make it easier for teachers to compose questions using technology. This interactive crossword puzzle creation software is easy to access with or without a network, so there is question-and-answer interaction during class learning. The development of interactive crossword puzzle learning media can provide new experiences for students participating in learning. Integrating word games as learning media raises students' enthusiasm for answering questions and increases students' motivation and interest in learning. The novelty of HTML-based interactive crossword puzzles in learning media has proven valid and practical for the learning process. This learning media is highly recommended because it can be used in other materials by changing the content of the interactive crossword puzzle learning media. This research implies that it can be used as an interactive learning media option that utilizes technology in schools to improve and determine students' understanding of the material provided. Meanwhile, the limitation of this research is that it was only carried out at the development stage. Further research can involve other stages so media development can be more optimal.

4. CONCLUSION

The product developed is HTM-based interactive crossword learning media with the ADDIE development model. Based on the results of the tests carried out, it was found that the media developed was valid and practical for use in the learning process. Apart from that, it is known that the media created can create a varied learning atmosphere. The novelty of HTML-based interactive crossword puzzles can make learning easier for teachers. Students also get a more meaningful learning experience through innovative learning media.

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