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Development of Digital Learning Materials Using a QR Code Based Book Creator Application to Improve Student Learning Outcomes in Science Subjects

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Abstract: This research aims to develop digital learning material using the QR Code-based Book Creator application to improve learning outcomes in science, especially on human digestive system material. This research uses the ADDIE development model. The results showed that the use of digital learning material using the QR Code-based Book Creator application was able to improve student learning outcomes as evidenced by an increase in the gain value of 0.39 in small groups and 0.54 in large groups with moderate categories. In addition, this digital learning material is also considered very feasible by experts with a feasibility score of 98.60% from media experts and 93% from material experts. Positive responses also came from teacher with a response questionnaire score of 95% and a student response score of 93.30% with very feasible criteria for use in learning the human digestive system. Based on these results, the digital learning material developed not only improves student learning outcomes on human digestive system material but the learning material is very feasible to use.

Keywords: Digital Learning Material, Book Creator, QR Code, Learning Outcomes

Introduction

Education is developing rapidly in the digital era. The rapid development of technology has significantly impacted various fields of life, including education. The development of education in the digital era allows students to access knowledge quickly and easily (Alshehri, 2024; Haleem et al., 2022). Therefore, the use of technology is one aspect that educational practitioners are increasingly considering. The influence of technology can have both positive and negative impacts on children (Hijriyani & Astuti, 2020; Rakhmawati et al., 2020). , emphasized that one of the negative impacts that arise is a sense of addiction and dependence on gadgets. A study by Damayanti & Gemiharto (2019), showed that excessive smartphone use in children can result in decreased concentration levels, difficulty maintaining focus, less active thinking, and obstacles in the learning process (Shanmugasundaram & Tamilarasu, 2023; Stevic et al., 2024; Swider-Cios et al., 2023). However, if utilized properly, smartphones can be a learning tool to improve student learning outcomes (Kurniawati, 2020).

According to a survey by Komisi Perlindungan Anak Indonesia (KPAI) in 2020, around 71.3% of school-age children have gadgets and use these devices for a long period every day. Of these, 55% spend time playing online or offline games (Griffiths & McLean, 2017). From this, the use of gadgets without being supported by knowledge and skills has a negative impact on child development, especially if there is no assistance from adults (Chavda & Nisarga, 2023). The use of gadgets at school age is often used for various entertainment daily

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activities such as watching YouTube, accessing social media, and playing games (Nikmawati et al., 2021). However, along with technological developments and educational needs, gadgets have also become an important tool in the learning process (Zain et al., 2022). With various educational applications and easy access to information through the internet, students can utilize gadgets to support their learning (Haleem et al., 2022; Ratnasari & Haryanto, 2019). For example, students can access learning materials through digital platforms.

The use of gadgets in learning not only improves students' technology skills but also allows students to learn interactively and flexibly. In this case, technology has become a necessity for education in the digitalization era in improving students' knowledge and skills (Sousa & Rocha, 2019). In this context, the use of digital learning materials is very relevant. Learning materials are things that are used by teachers or students to facilitate the learning process (Area-Moreira et al., 2023). Learning materials can be in the form of reading books, Student Worksheets, visual presentations, newspapers, digital materials, food packages, photos, direct conversations with native speakers, instructions from teachers, written assignments, cards, or discussion topics between learners (Pulungan et al., 2022).

There are many variations of making digital learning materials. Book Creator is an application used to create e-books in which there are tools for creating attractive books (Astutik & Rizkillah, 2022). One of the benefits of Book Creator is that it can be accessed directly through the web using a smartphone without the need to download additional applications or software, so students can use it easily anywhere as long as there is an internet connection. Book Creator as a digital book is practical to use, the use of Book Creator obtained learning completeness rather than using conventional learning materials (Palupi et al., 2022). The use of Book Creator in creating learning materials will be more optimal if combined with QR-Code. QR Codes or Quick Response Codes are black modules arranged in a square pattern on a white background. By integrating the QR Code to access learning materials, it makes it easier to access material for students (Belhan et al., 2023).

When students or teacher scan the QR Code with their smartphone or tablet, it will be directly directed to the digital learning materials in Book Creator without the need to type the URL or do a manual search. This not only increases efficiency and convenience but also opens up opportunities for more extensive and flexible interaction with the learning materials. Thus, QR codes become a "bridge" that provides quick and easy access to interactive digital learning materials. Based on the results of interviews with the Principal and Teacher of 5th grade and observations at Pandean Lamper 05 Semarang Elementary School, it was found that this school faces a major problem in the form of a lack of learning materials. Currently, learning relies very much on textbooks.

Science subjects have the lowest average summative assessment compared to other subjects. Students are also less motivated to learn in class and independently at home. The lack of learning materials leads to a lack of available information. Science material about the human digestive system is quite complex because some many contents and visuals must be memorized. Therefore, we need additional learning material that are interesting, innovative, and practical to increase students' reading references. The researcher wants to develop digital learning material using the QR-code-based Book Creator application. It is expected that this digital learning material can improve student learning outcomes and make it easier for students to learn anywhere and anytime.

Method

The type of research is Research and Development. In research and development, the main goal is to develop a product based on the results of field trials and then make revisions. Products that are developed in Research and Development research fulfill the standards of effectiveness, efficiency, and quality (Sarpong et al., 2023). The development model used is ADDIE. The stages of the ADDIE model according to Nita et al. (2022) consist of analysis, namely analyzing the problems and needs of the research subject, design, namely designing the prototype of the product to be developed, development, namely developing the product that has been designed, implementation, namely testing the product on the research subject and evaluation, namely evaluating the shortcomings of the product that has been tested.

The research subjects were 5th grade students of Pandean Lamper 05 Semarang Elementary School with a total of 27 students. The types of data used are qualitative and quantitative data. Qualitative data was obtained from interviews with the principal and 5th grade teacher of Pandean Lamper 05 Semarang Elementary School and observations of the physical and non-physical conditions of the school, as well as from the suggestions of the validators. Meanwhile, quantitative data was obtained from the results of the validation of QR Code-Based Digital Book Creator Learning Material by experts using scores from validation instruments filled out by material experts and media experts, questionnaires of student and teacher responses during product trials, as well as pretest and posttest results of students.

Result and Discussion

Stages of Developing Digital Learning Material

The development stage of Digital Learning Material using the QR-Code-based Book Creator application to improve learning outcomes in science subjects on human digestive system material 5th grade at Pandean Lamper 05 Semarang Elementary School is carried out with the ADDIE model which has five stages, namely analysis, design, development, implementation and evaluation. The stages to produce digital learning material using the QR-Code-based Book Creator application are as follows:

Analysis

The analysis was identified through interviews and observations. The results of interviews and observations show that students only get their learning material from textbooks and there are limited media in learning, the results of summative assessments in Science subjects get a low average, and learning material about the human digestive system is considered difficult by students, learning has not utilized technology such as the use of learning material in digital form (Fadlia et al., 2022). There for, these problems encourage the researcher to develop digital learning materialteac using the QR-Code-based Book Creator application.

Design

The design of this product using Canva includes front and back covers, preface, table of contents, instructions for using learning material, student activity instructions, concept maps, learning outcomes, learning goals, introduction, material, quizzes, summaries, bibliography, and developer profiles. This learning material is also equipped with interesting images and educational videos. The stages in designing learning material are compiling material about the human digestive system, choosing the use of colors and fonts, determining themes, determining icons, determining images, finding videos and creating layouts.

Development

Learning material that have been designed through Canva are uploaded to the Book Creator application and published. When published in Book Creator, a scannable QR-Code appears so that readers only need to scan the QR Code to read the learning material, making the process faster and easier.

Implementation

Product implementation is carried out after the product is validated by media and material experts. The next step is to test the product. Trials were conducted to get student and teacher responses on the use of digital learning material using the QR-Code-based Book Creator application. The small group trial involved 6 students while the large group trial involved 21 students. In the small and large group tests, pretest and posttest as well as teacher and student response questionnaires were given. The questionnaire of students' responses to digital learning material using the QR Code-based Book Creator application reached 93.30% with very feasible criteria. In addition, the teacher's response questionnaire to the learning material developed was 95% with very feasible criteria.

Evaluation

At the evaluation stage, an assessment is carried out to assess whether the digital learning material developed using the QR-Code-based Book Creator application has met the goals (AlNajdi, 2022; El-Sabagh, 2021; Mhlongo et al., 2023). In addition, the evaluation also aims to identify and improve the shortcomings that exist in this digital learning material (Mertasari & Candiasa, 2022; Reichert-Schlax et al., 2023; Timotheou et al., 2023; Tomczyk et al., 2020).

Media Expert Validation Results

Media validation aims to assess whether the developed product functions properly in terms of its media products (Dwivedi et al., 2021; Shahbaznezhad et al., 2021). The results of the media expert validation are as follows.

Table 1. Media Expert Validation Results

Question	Score
Quality of content and purposes	
Suitability of material with learning goals	5
Educational content	5
Attracts student interest	5
Ideal size for small and large groups	5
Instructional quality	
Easy operation	5
Motivates student learning	5
Economical and practical	5
It can be used in other learning	5
User interface	5
Interesting	5
Technical quality	
Selection of font type and size	4
Media can be seen clearly	5
Color selection	5
Button works well	5
The interface is suitable for the topic	5
Total score	74
Percentage score	98.60%
Criteria	Very feasible

$$P = \frac{f}{N} \times 100\% \quad (1)$$

$$P = \frac{74}{75} \times 100\%$$
$$P = 98.60\ \%$$

Based on Table 1 the results of media expert validation the score earned from the three indicators is 74 with a percentage of 98.6%. It can be concluded that the QR Code Based Digital Book Creator Learning Material is very feasible to use. The revision from the media expert is that the images of digestive organs used must be concrete, not animated.

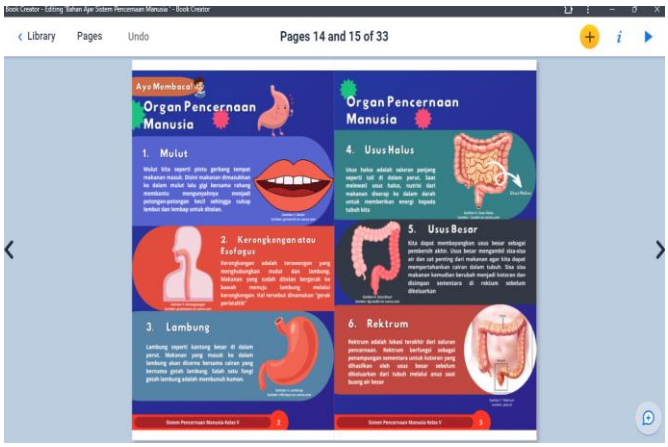

Figure 1. Before revision still used images that are not concrete

Figure 2. After revision changed non-concrete images to concrete ones

Material Expert Validation Results

Material validation aims to ensure that the learning materials presented in learning materials are suitable and in accordance with learning needs. The results of the material validation are as follows Table 2.

Based on Table 2. The results of the material expert validation the score earned from the five indicators is 70 with a percentage of 93%. It can be concluded that the QR Code Based Digital Book Creator Learning Material is very feasible to use. The revision from the material expert was the adjustment of evaluation questions to the cognitive level of students and the addition of material in learning material regarding the anatomy of the oral cavity and parts of the stomach.

Table 2. Material Expert Validation Results

Question	Score
Accuracy with learning goals	
Suitability of content with learning outcomes	5
Suitability of material with learning goals	4
Fit with students's level of thinking	
Suitability of the content with the typical student characteristics	5
Suitability of the content to the level of students' thinking	5
Support for learning content	
Sufficiency of the material as a whole	4
Communicative and easy to understand	4
Content is complete and systematic	4
Implementation of theory with daily life	5
Interesting	5
Image can facilitate goal achievement	
Images suitability with the content	5
Clarity of the images in explaining the content	5
Proper to support the content of lessons that are facts, concepts, principles, or generalizations	
Explanation of the content facilitates student understanding	5
The content increases student's knowledge	5
Questions challenge students' critical thinking	4
Improvement in student learning outcomes	5
Total score	70
Percentage score	93%
Criteria	Very feasible

$$P = \frac{f}{N} \times 100\% \quad (2)$$

$$P = \frac{70}{75} \times 100\%$$
$$P = 93\ \%$$

Figure 3. Before revision the mouth and gastric contents were incomplete

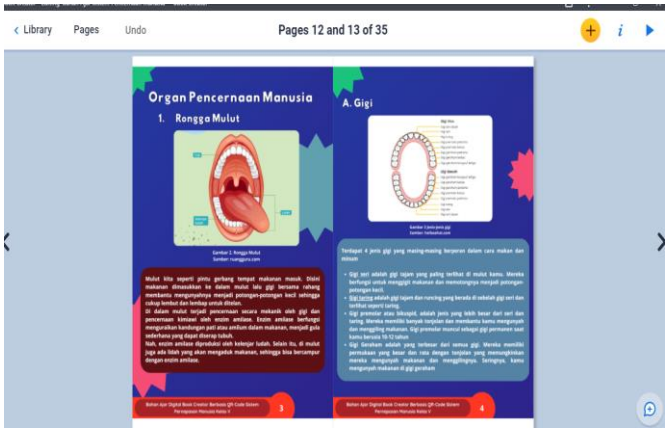

Figure 4. After revision added parts of the oral cavity that is the teeth

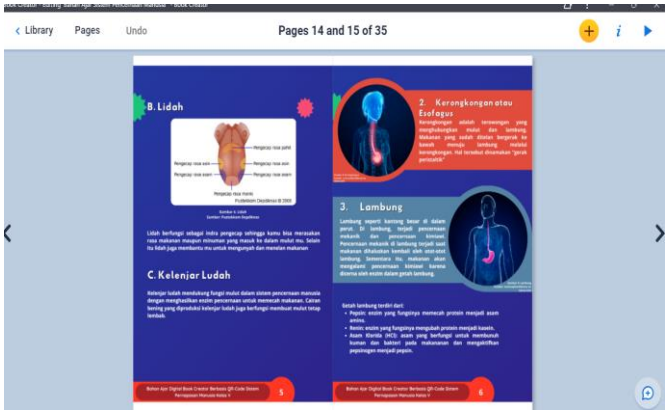

Figure 5. After revision added parts of the oral cavity such as the tongue and salivary glands

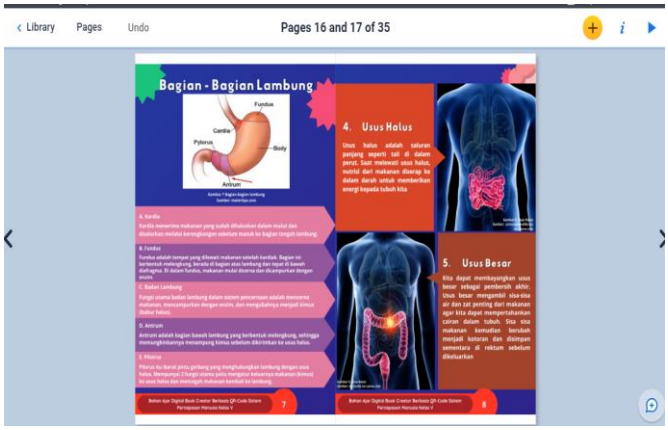

Figure 6. After revision added parts of the gastric

Improvement Results of Science Subjects on Human Digestive System Material

QR Code-based Book Creator digital learning material can be used if there is an increase in the learning outcomes of Science Subject human digestive system material. Data on student learning outcomes are obtained from the results of pretests and posttests conducted by small groups and large groups. To analyze students' understanding of human digestive system material, normality test, paired sample t-test, and N gain were used to test. The results of the analysis of the increase in learning outcomes of Science Subjects on human digestive system material are as follows.

Normality Test

The normality test of this study was processed using SPSS Version 25 with the Shapiro-Wilk statistical method because the sample was less than 50 people. Based on the pretest results in the small group trial, it is known that the significance level is 0.065> 0.05 and in the posttest the significance level is 0.55> 0.05, which means that from the pretest and posttest H0 is accepted, it is stated that the data is normally distributed. Meanwhile, the normality test from the pretest results of the large group test found a significance level of 0.31> 0.05 and on the posttest obtained a significance level of 0.25> 0.05, which means that from the pretest and posttest H0 is accepted, it is stated that the data is normally distributed.

Paired Sample T-Test Test

The results of the paired sample t-test test showed a significant difference between pretest and posttest scores in the small group trial the sig value (2-tailed) is 0.002 <0.05 and in the large group trial the sig value (2-tailed) is 0.000 <0.05, indicating that the application of QR Code-based Book Creator digital learning material positively affects the improvement of student learning outcomes in Science subject especially on the topic of the human digestive system in 5th grade Pandean Lamper 05 Semarang Elementary School.

N Gain Test

N Gain is obtained by comparing the difference between pretest and posttest scores with the difference between the ideal maximum score and pretest score. Data on the results of pretest and posttest scores and the improvement of learning outcomes of the human digestive system, N-Gain Score can be seen in the Table 3.

Table 3. N-Gain Results of Small Group Trial

Average Pretest	Average Posttest	Maximum Scor	Difference Average	N-Gain Score	Category
64.17	78.33	100	14.16	0.39	Medium

Based on Table 3, the N-Gain results in the small group test with a subject of 6 students showed that the average increase in pretest and posttest was 0.39 with a moderate category. The difference between the average pretest and posttest scores was 14.16.

Table 4. N-Gain Results of Large Group Trial

Average Pretest	Average Posttest	Maximum Scor	Difference Average	N-Gain Score	Category
45.71	75.48	100	29.77	0.54	Medium

Based on Table 4, the N-Gain results in the large group test with a subject of 21 students showed that the average increase in pretest and posttest was 0.54 with a moderate category. The difference between the average pretest and posttest scores was 29.77. From these results it can be concluded that learning using QR Code-based Digital Book Creator learning material on human digestive system material has succeeded in improving the learning outcomes of 5th grade students at Pandean Lamper 05 Semarang Elementary School. Based on the stages that have been passed starting from product development, trial use of students, and analysis, the researcher determines several benefits of QR Code-Based Digital Book Creator Learning Material, namely increasing student learning outcomes in Science subjects on human digestive system material, increasing student motivation in reading, helping students learn anywhere and anytime because they use smartphones, encouraging students to be more independent in learning because the learning material have edu-game, and attracting student interest in studying the human digestive system because the reading is equipped with pictures, videos, and edu-game (Idayanti et al., 2023; Marpelin et al., 2023; Tanjung & Harahap, 2023).

In addition to its benefits, QR Code-Based Digital Book Creator Learning Material also has several weaknesses, including QR Code-Based Digital Book Creator Learning Material can only be opened on Android or IOS-based, learners who do not have a built-in QR Code scan application from a smartphone must download it through PlayStore or Apple Store so that if the storage memory is not enough to download a new application, the learning material cannot be accessed. to play video shows and edu-game students need to be connected to an internet connection, determine student learning discipline becomes more difficult because sometimes students are too focused on playing edu-game, and are more effective if used individually because the sight distance on the smartphone needs to be connected to an internet connection, determine student learning discipline becomes more difficult because sometimes students are too focused on playing the edu-game (Vlachopoulos & Makri, 2017), and is more effective when used individually because the viewing distance on the smartphone is limited to the width of the smartphone screen (Boccardo, 2021; Heitmayer, 2022; Sung et al., 2016).

Conclusion

The results showed that the development of digital learning material using the QR Code-based Book Creator application is very feasible to use in the learning process in the classroom. This is based on media and material validation test data. Validation from media experts showed excellent media quality with a score of 98.60% while validation from material experts scored 93%. Digital learning material using the QR Code-based Book Creator application can improve learning outcomes in science on human digestive system material. The increase in student learning outcomes is indicated by a gain value of 0.39 in the small group and 0.54 in the large group which indicates that the increase in learning outcomes is in the moderate category. The use of digital learning material using the QR code-based Book Creator application obtained a teacher response questionnaire result of 95% with very feasible criteria and a student response questionnaire result of 93.30% with very feasible criteria.

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Conceptualization, methodology, validation, formal analysis, investigation, resources: A. D. W., data curation, writing—original draft preparation.; writing—review and editing, visualization: M. F. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare that there is no conflict of interest.

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