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Digital Text Books Based Multi Application: Does it Have Impact Towards Elementary Students Intelligence and Ecology Awareness?

Achmad Fanani[1], Cholifah Tur Rosidah[2*], Triman Juniarso[3], EldineSalsabila Putri[4], GresyaAilina Roys[5], Vannilia[6]

[1,2,3,4,5,,6] Department of Elementary Teacher Education, Universitas PGRI Adi Buana, Surabaya, Indonesia

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ABSTRAK

Kepedulian dan kepekaan manusia terhadap masalah lingkungan hidup merupakan entitas moralitas, perilaku, dan karakter individu manusia. Hal tersebut tidak dapat dibangun dalam diri manusia secara instan, oleh karena itu metode pendidikan merupakan langkah strategis untuk menumbuhkan dan meningkatkan pengetahuan, keterampilan, dan perilaku individu manusia sebagai pembelajar pada usia dini, sehingga menjadi individu yang berwawasan lingkungan dan memiliki perilaku hijau juga memiliki karakter positif. Penelitian ini bertujuan untuk mengembangkan bahan ajar digital berbasis multi aplikasi. Penelitian ini menggunakan desain penelitian dan pengembangan, dengan model 4D yang terdiri dari tahap define, design, develop dan disseminate.Subjek penelitian ialah siswa kelas 5 Sekolah Dasar. Jenis penelitian yaitu pengembangan dengan model 4D. Metode pengumpulan data dilakukan dengan penyebaran angket. Instrumen pengumpulan data berupa kuesioner.Teknik analisis data menggunakan analisis deskriptif kualitatif, kuantitatif, dan statistic inferensial. Hasil penelitian menunjukkan nilai ketuntasan belajar materi energy dan pengetahuan ekologi pada kelas eksperimen sebesar 83% pada kelas eksperimen dan 74% pada kelas kontrol. Hasil tersebut membuktikan bahan ajar digital berbasis multi aplikasi berdampak pada kecerdasan siswa dan kesadaran ekologinya. Kesadaran ekologi dapat terbentuk sejalan dengan pemahaman ekologi dan kecerdasan yang meningkat.

ABSTRACT

Human concern and sensitivity to environmental problems is an entity of morality, behavior, and character. It cannot be built in humans instantly; the educational method is a strategic step to grow and improve the knowledge, skills, and behavior of individual humans as learners at an early age so that they become environmentally sound individuals with green behavior and a positive character. This study aims to develop multi-application-based digital teaching materials. This study uses a research and development design, with a 4D model consisting of define, design, develop, and disseminate stages. The research subjects were 5th-grade elementary school students. This type of research is developed with a 4D model. The method of data collection is done by distributing questionnaires. The data collection instrument is a questionnaire. Data analysis techniques using descriptive qualitative analysis, quantitative, and inferential statistics. The results showed that the mastery value of energy and ecological knowledge in the experimental class was 83% in the experimental class and 74% in the control class. These results prove that multi-application-based digital teaching materials impact students' intelligence and ecological awareness. Ecological awareness can be formed along with increased ecological understanding and intelligence.

1. INTRODUCTION

Human concern and sensitivity to the environment a problem is a form of morality, behavior, and individual human character. Conserving and keep the environmental balance is a form of every human's responsibility in ensuring our common future and sustainable development (Izhar et al., 2022; Varela-Candamio et al., 2018). That is why, the nation has an important and strategic role inenvironmental safety,

Corresponding author
*E-mail addresses: cholifah@unipasby.ac.id (Cholifah Tur Rosidah)

by applying various programs and regulation efforts to overcome the living environment's problems. These matters have been supported with the establishment of The Specific Board and Institution which handles Living Environment (Khairuddiniyah, 2018; Wasino et al., 2020).

Program and regulations which have the quality to supervise, persuasive or threat have been carried out by the center and region government, however those efforts looks infertile when it faces with the massive living environment's damage. Various cases and natural phenomenon occurs both globally and nationally, most of them are resourced from human's attitude which irresponsible, ignorant and selfish. For example, flood occurred because human dumping their trash carelessly, cutting the trees offhanded, constructing buildings at the river banks e.t.cIn this contemporary era environment issus that has become global problem in fact is affected by human's ability to empower the nature, until it is exaggeratedly used for the sake of human necessities (Hendarwati et al., 2021; Yunansah & Herlambang, 2017). Center Statistics Bureau explained about living environment ignorance attitude, Indonesia shows 0.53 index in East Java. That index mentioned, is more than national index of 0.51. The index shows that nature literate society is quite low (Adela, 2018; Ivashova et al., 2019).

A person who has a high knowledge about environment not a guaranteed also has a positive attitude towards the environment, therefore they can act harmfully and even dangerously to the environment (Wasino et al., 2020; Yamin & Karmila, 2020). This is in accordance with research result stated that intrapersonal dimension in moral development arranges one's activity when involved in a social interaction and intrapersonal dimension which manages social interaction and conflicts completion (Paulus, 2020). This need to get teacher's attention in the process of knowledge learning, skill, and student's attitude must be designed and developed proportionally. It is impossible to cultivate in humans instantly. Therefore, education is a strategic way to increase the knowledge, skills, and attitudes of the human person as a student from an early age. Many people believe that education can shape the personality and character of students (Defitrika & Mahmudah, 2021; Paulus, 2020). Through educational programs that integrate environmental material into the curriculum and habituation programs, students are expected to become part of a society that is very concerned about the environment and its impacts (Rosidah et al., 2022; Yildirim, 2017). Learning materials for elementary school students should be fun. Children enjoy having colorful materials filled with pictures, and they also enjoy learning from stories (Aura et al., 2021; Cekaite & Björk-Willén, 2018). Therefore, making these materials available to young learners will help them enjoy learning while increasing their understanding of the content. In addition, providing the right material for students has been shown to have a positive impact on student achievement (Abubakar, 2020; Ebersbach & Brandenburger, 2020).

Based on several findings, review and clarified reason related with ecology concept learning, living environment, needed a student's learning source development that according to the characteristics of student and material, so that student can achieve study result not only the concept of knowledge and skill aspects, but also nurturing effect of positive and strong knowledge and skill and impressed on the students themselves. Therefore, it is necessary to develop learning resources in the form of digital teaching materials based on multi-application material on energy and human lifewhich can have a positive effect on motivation and student achievement. In particular, this article analyses the design of the digital textbooks developedand effectiveness of the digital textbooks developed

2. METHOD

This research intends to produce a digital teaching materials based on multi-application material on energy and human life. This research method used is research and development (R&D) which refers to the 4D research and development model. 4D Development model consists of define, design, develop and disseminate stage (Thiagarajan, 1974). Define stage is an instructional requirements stage which purposedly is to define and design study and necessity requirements (Richey et al., 2004). Define stage is done through the front-end analysis stage, learner's task analysis, and concept analysis. Design stage is a system to design prototype of the lesson material. Design stage is executed with constructing criterion-referenced test, media selection, format selection and initial design procedures. Develop stage is intended to modify the prototype that has been made. Prototype made previously, must have been modified to be an effective final version. In this development stage, follow ups are accepted from the expert appraisal and development testing. The lesson material reaches into final product when the examination and development stage has produced a consistent result and expert assessment has also produced a positivecomments. Dissemination stage consists of of 3 phases, i.e usability, packaging also diffusion and adoption (Huang et al., 2020). Those stages and its necessities for obtaining data can be seen in Figure 1.

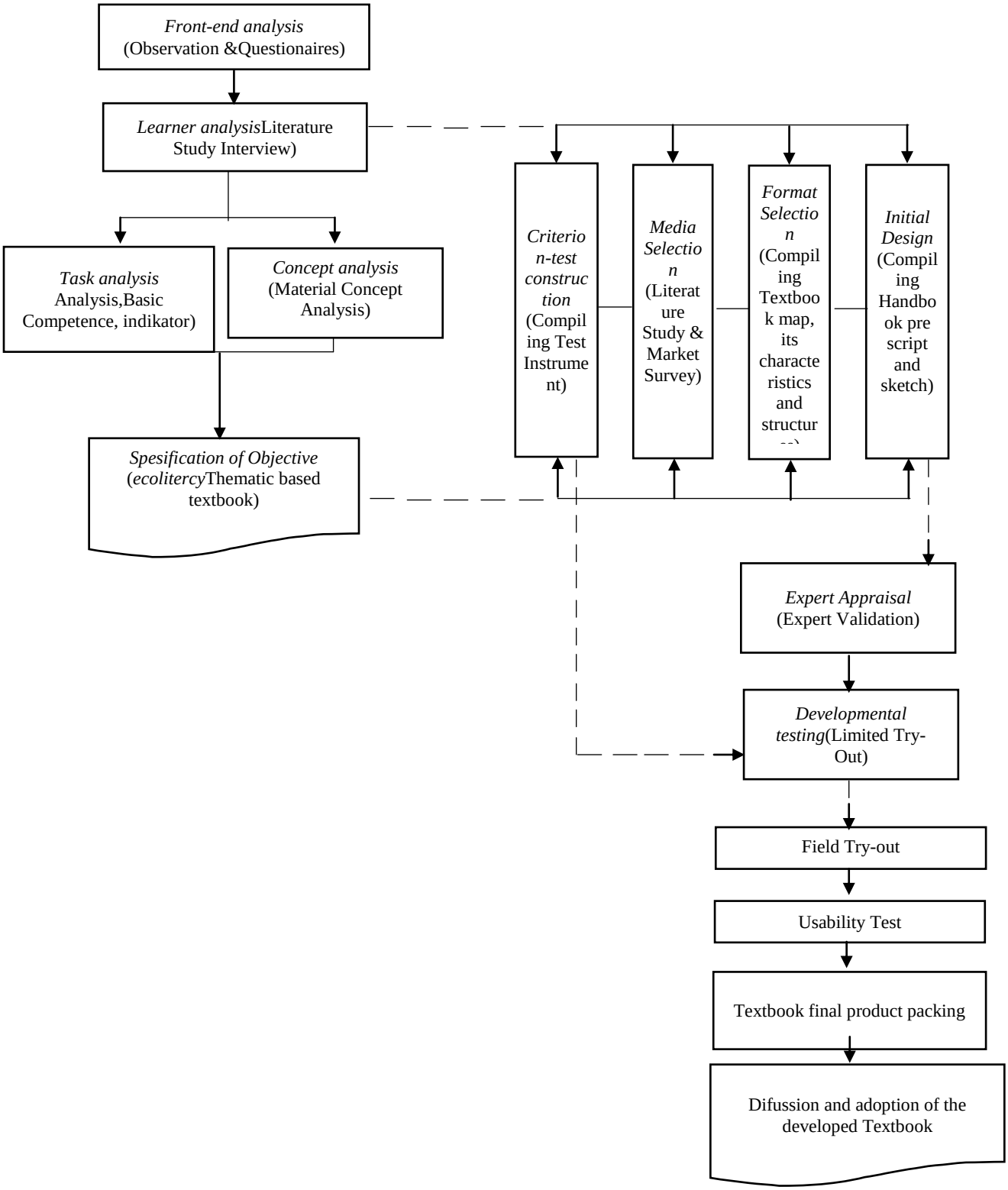

Figure 1. Stage on the Research of Developing Digital Teaching Materials Based on Multi Application using 4D Model

The research was carried out in the Hang Tuah Elementary School District Waru, County Sidoarjo, East Java-Indonesia. Sampling techniques used is randomn sampling. This has been claimed as the best techniques reviewed from the theoretical, experimental and empiric sides.

Data obtaining tecniques is done by observation, interview, questionairres, documentation and test. Every data obtaining needs an instrument so it will be easy and directed within the process. Research instruments is a must in every research execution process (Rachmadtullah et al., 2018). Instruments used

in this research are; observation research to observe student's ecology awareness behavior, interview list to gain a deeper information from the students and teachers about their needs toward digital teaching materials based on multi-application.The lattice of students' ecological awareness behavior is presented in Table 1.

Table 1. Student Ecological Awareness Behavior Grid

Component	Description
Implications	1. Concern for the environment, respect for the environment, responsible for pollution, technology, economics, and environmental conservation issues. 2. Identify and choose a positive perspective on environmental issues. 3. Participate actively in the improvement and conservation of the environment, confident in making decisions about environmental issues in accordance with moral values.
Ecological Knowledge	1. Ability to communicate and apply ecological concepts, especially focusing on individuals, species, populations, communities, ecosystems, and biogeochemical cycles. 2. Understanding of energy production and transfer, and the concept of interdependence, niche, adaptation, stability of organisms, and humans as ecological variables. 3. Understanding of how natural systems work, as well as how the relationship between social systems and natural systems.
Political Social Knowledge	1. A clear awareness of Indonesia's economic, social, political and ecological dependence on both urban and rural areas. 2. Knowledge of how human cultural activities affect the environment from an ecological perspective. 3. An understanding of the basic structure and scale of societal systems and the relationship between religion, political structure, and environmental values of various cultures. 4. Understanding of geography at the local, regional, national and global levels as well as patterns of change in the social and cultural aspects of society.
Knowledge of environmental issues	1. Understanding of various problems and issues related to the environment which are influenced by aspects of politics, education, economy, and government institutions. 2. Understanding of air quality, water quality and quantity, soil quality and quantity, land use and management for wildlife habitat and human population, health, and waste
Cognitive Ability	1. Identification and definition of environmental problems/issues, and analysis, synthesis and evaluation of information on these issues using primary and secondary sources and one's personal perspective. 2. The ability to choose the right strategy or action as well as create, evaluate, and implement actions from the plans that have been designed. 3. Ability to carry out scientific investigations and analyzes of environmental risks scientifically, to think systematically, predictably, progressively, innovatively.
Responsibility to environment	1. Active participation aimed at solving and solving problems. Action through selected lifestyle activities, including environmentally friendly consumers in purchasing transactions, use of methods to conserve natural resources, enforcement of environmental regulations. 2. Conducting interpersonal relationships that encourage environmentally friendly activities; and support environmentally friendly policies.

Validation sheet is used to validate the digital teaching materials based on multi-application from the content and media design side. Test sheet is to measure material comprehension and student's ecology intelligence.

To test the hypothesis, Quasi Experimental Research is done. In this design, there are 2 groups which selected randomly (Gay et al., 2012). Experiment class group is given treatment (X) with study that uses digital teaching materials based on multi-application. Control class group is given treatment (Z) with study that uses national standard textbooks. Both group has been assessed on the daily basis test as a pre-

test assessment (Y1) to measure student's pre-ability condition between experiment and control class. After getting the treatment, both classes are being tested to do post-test, so it will be assessment test (Y2).

In this research, one of the requirements is that the sample has the similar ability. Therefore, normality and homogeneity test are done to know that those 2 samples come from a normal distributed population and homogeny variation. The data which is used are thematic lesson daily basis test onmaterial on energy and human life. Normality, homogeneity, and hypothesis are counted with SPSS version 22 program.

3. RESULT AND DISCUSSION

Result

The stages of Digital Teaching Materials Based on Multi-Application Development Process

Digital teaching materials based on multi-application is developed as an alternative and innovative teaching material in this science and technology era, as of todays. The development process uses four 4D model stages, i.e (1) Define is carried out by literature study and empirical/field study. (2) Design is carried out by validation of the expert (expert judgment) including content validation (content expert judgment) and design and media validation (design and media expert judgment). The activity of product validation is able to give input so that the product can be valid and reliable. Critics and suggestions which are given can be a pre-stage revision material, until the product is ready to be tried-out. First try-out is done to a low, middle and high learner's level one by one (one to one leaner). Then a limited scope is being carried by usability test on a broader sample to spread and implement the products.

The Characteristics of a Developed Digital Teaching Materials Based on Multi-Application

The characteristics of the multi-application-based digital teaching materials developed are combining media applications combined with a blended learning approach. multi-application-based digital teaching materials combine text, graphics, videos, images, and student activities through various applications. This simple product is also combined with energy material content which can educate students about ecoliteracy. The characteristics of the multi-application-based digital teaching materials developed include book design, coloring, book covers, types of images and writing.

Design is a frame or outline that systematically describes the entire contents of the book. This multi-application-based digital teaching material was designed on a 14.8 x 21 cm book using the Flip Builder application. The plot of the teaching material is adapted to the material on energy for grade 5 students which consists of sub-materials on energy in human life, energy in global life, the importance of saving energy, energy crisis, and alternative energy sources. Ecoliterate content is made up of images and materials inserted in every form; material, activities, assignments and supporting illustrations that are contextual in nature and also close to the student's world according to the characteristics of grade 5.

The cover design is also made to describe the content of teaching materials. The cover section describes the character of the students who will play a role in the teaching material. Smooth and nice natural background shows a closer part of students to study according to learning goals. The illustration design is kept simple so that it is not too dense and distracts from reading the title. The cover can be seen in Figure 2.

Figure 2. Cover Multi Application Based Digital Teaching Materials

The colour selection is made colourful to attract student's interest. However, the colours chosen are soft so that it will be attracting to read. A font type used is Arial Black, so that the students can read the letters clearly. The front part of the cover contains title, author and publisher; whereas the back cover

consists of blurb, publisher identity and ISBN of the textbook. Activities that contained in multi-application-based digital teaching materialsis show in Figure 3.

Figure 3. Activities Contained in Multi Application Based Digital Teaching Materials

In multi-application-based digital teaching materials there are several activities that students can do to explore their knowledge, including (1) observing activities, (2) collaborative activities, (3) practical activities, (4) reflection activities, (5) exploratory activities, (6) challenge activities, (7) meaningful activities, and (8) find out more activities.Material in multi-application-based digital teaching materials is show in Figure 4.

Figure 4. Material in Multi Application Based Digital Teaching Materials

Multi-application-based digital teaching materials containing the development of energy material is a combination of learning media technology, lesson content, and ecoliteracy content which aims to provide understanding to students so that they can improve critical thinking skills, higher order thinking skills to acquire material knowledge by observing, asking questions, reasoning, managing information and communicating the results obtained, so that students actively participate in learning. In addition, students can also obtain additional information and knowledge about how to love and protect the environment, so that ecological intelligence and awareness begins to grow and develop.

In multi-application-based digital teaching materials that contain the learning process, the flip builder application is used. This application activates e-books like printed books that can be flipped from the front page to the back page. Students can download the application and it will automatically be installed on the user's cellphone or the user's computer. besides that, multi-application-based digital teaching materials also use the Phet application, as a medium for carrying out scientific experiments or simulations; Thinglink as a medium for providing information to students regarding the concepts needed, besides that this application also functions to provide understanding questions to students; Mind master as a medium to provide worksheets in the form of concept maps that students can fill in; Live worksheets are used as media to provide experimental or practical activities; Canva is used to design the appearance of teaching materials; The Google form is used for posttest evaluation questions for each chapter and

Picsart is used to edit cover photos and book covers. Material contained in the thinglink application in multi-application-based digital teaching materials is show in Figure 5. Examples of evaluation questions are loaded in the Google form in multi-application-based digital teaching materials is show in Figure 6.

Figure 5. Examples of Material Contained in the Thinglink Application in Multi Application Based Digital Teaching Materials

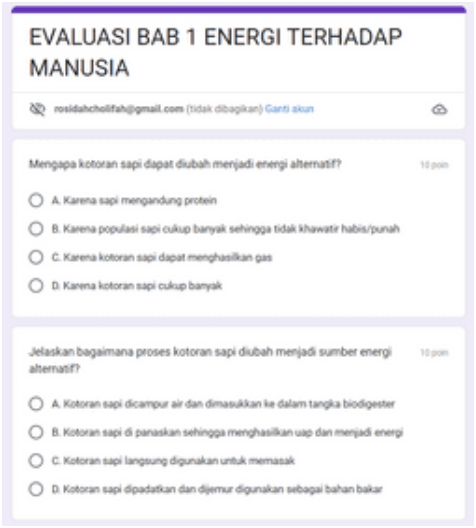

Figure 6. Examples of Evaluation Questions are Loaded in the Google Form In Multi Application Based Digital Teaching Materials

The effectiveness of the developed multi-application-based digital teaching materials. Criteria for the effectiveness of multi-application-based digital teaching materials developed in this study are indicated by student learning outcomes after being given learning treatment using multi-application-based digital teaching materials. In the learning effectiveness test stage, it was carried out on 28 respondents from class 5 students in the experimental class. And then the learning outcomes were tested by the hypothesis with the learning outcomes of the control class. Based on the hypothesis testing carried out with the SPSS application, the results obtained H_0 were rejected, meaning that the learning outcomes of the experimental class were close to being better than the control class. In addition, it was also shown that the completeness test for the experimental class reached 83%, while the mastery test for the control class was only 74%. These results indicate that the classical completeness in the experimental class is better than the control class.

Discussion

The stages of digital teaching materials based on multi application development process.This research refers to the research and development (R&D) research of the 4D (four-D) research and development model.The 4D R&D model includes 4 main define, design, develop and dissemination. The 4D development model can be adapted to 4D namely: defining, designing, developing, and distributing.

Those 4 stages of the 4D models, as mentioned, showing a vivid and continuous influence amongst the stages. In other words, systems within the 4D model is very concise, but the contents is dense

and vivid from the first stage to the next. 4D model's character is very detail and comprehensive on the analysis and evaluation stages. This is in line with the research opinion which explains that 4D model refers to the basic level of the learning development stage., so this model is appropriate to be applied on the skill-based lesson (Parmentier et al., 2021; Rany et al., 2020). It means that this model is systematic and suitable to develop digital teaching materials based on multi-application.

Based on the explanation above, digital teaching materials based on multi-application development is very suitable to use 4D model because it is approach-system oriented, learning system design model has long been used to create an effective, efficient and interesting learning program. This model assessed that all component affects the other component so that they are in a unity.However, in this study there were limitations in the implementation of dissemination. Dissemination of multi-application-based digital textbooks is limited to elementary schools located on the Java island.

The characteristics of a developed digital teaching materials based on multi application.The characteristics of multi-application-based digital teaching materials include the development of energy materials with ecoliterate content inserted in elementary schools in accordance with textbooks that have been developed by the government as teaching materials in the curriculum learning mechanism.In addition, the characteristics of multi-application-based digital teaching materials have also received suggestions from teachers so that they are adapted to the characteristics of fifth grade elementary school students. Researchers follow the teacher's and curriculum suggestions because learning materials must be valid and in accordance with the characteristics of students, so as to facilitate the learning process. This validity is very important to ensure that learning materials can help students achieve learning goals (Betschart et al., 2019; Cekaite & Björk-Willén, 2018)**.**

Materials, activities, assignments and supporting illustrations made in digital form can attract students' interest in learning and motivate them in solving the problems presented.This is also in line with Nieto who stated that developing digital-based textbooks can contribute to solving existing problems in the learning process (Adi et al., 2023; Alwi & Aulia, 2023; Nieto-Márquez et al., 2020). It can be concluded that this digital teaching material is an effective tool to improve the teaching process.

Based on the explanation above, it can be concluded that the theoretically developed characteristics of multi-application-based digital teaching materials are in accordance with the applied curriculum and provide alternative teaching materials to students and teachers to understand lessons and additional material.

The effectiveness of the developed multi application based digital teaching materials.

Based on the results of the effectiveness test above, it can be stated that the multi-application-based digital teaching materials developed are textbooks that have been tested to be effective, so that they can be considered as alternative textbooks that can improve student achievement in learning in elementary schools. The results of this study are in line with research that learning using digital teaching materials will show better results (Demirkan, 2019).

During the field research process, learning activities were carried out using multi-application-based digital teaching materials, students looked enthusiastic, so the learning process was Student Centered. This means that learning is active and interactive. Students understand the material more easily, so that the application of learning using multi-application-based digital teaching materials is considered effective for improving learning outcomes. This research is in line with study who stated that learning using digital teaching materials can improve student achievement and train students' rationality, subject matter is easier to understand, even other findings show that digital teaching materials can increase imagination (Gusman et al., 2021). The use of educational digital teaching materials has also proven to make it easier for students in the learning process because they learn happily by looking at lots of illustrations.

Learning using multi-application-based digital teaching materials can increase students' interest in learning because the digital teaching materials developed are a combination of text, illustrations, and animations made with very interesting methods with the learning process so that students can easily follow their uses. Increased interest in learning shows that digital teaching materials can increase interest in learning. This research is in line with study who stated that the digital teaching materials developed are feasible and effective for increasing interest in learning and student achievement (Ren et al., 2016). It can be said that there is an influence on the use of digital teaching materials and learning interest on learning outcomes.

Learning by using multi-application-based digital teaching materials has a significant role in enhancing student learning experiences and can train critical thinking to solve a problem and develop material obtained by students. Previous research has also suggested that the use of learning aids in the learning process using digital textbooks that are easy or user friendly will make the learning process effective and enable students to build their knowledge concepts actively (Sariyatun et al., 2018). Multi-

application-based digital teaching materials in elementary schools are recommended as alternative teaching materials that can increase knowledge and affective aspects for students. This research is also in line with study who stated that learning using digital teaching materials provides alternatives and effective methods for improving students' cognitive and affective abilities (Zutiasari & ., 2021).

Learning by using multi-application-based digital teaching materials is more effective because it is designed for students who have different levels of knowledge. This can stimulate and motivate students who have not reached a higher level of knowledge. Learning using multi-application-based digital teaching materials is effective because it gets positive responses from Grade 5 learning users, with the help of digital teaching materials the learning process becomes more exciting and fun. Students are motivated to learn because they can get learning messages easily. This is in line with previous research stated that the learning process using digital teaching materials is currently increasing rapidly, so that students give positive responses in using these digital teaching materials (Lin et al., 2017). It can be interpreted that the role of technology provides evidence to facilitate the learning process.

The contents of the digital teaching materials developed are effective for improving thinking skills because in the learning process using these digital teaching materials there are several questions that ask students to conclude, analyze, apply and synthesize. To answer assignment and evaluation questions in textbooks, Higher Order Questions (rich questions) skills are needed, high-level reasoning, namely high-level logical thinking methods. This thinking method is needed by students in the learning process, especially in asking questions, because it is necessary to use the knowledge, understanding and skills they have and relate them to new situations.Based on the results of the research and discussion, the development of multi-application-based digital teaching materials has been carried out through a systematic research process and also with validation tests, field tests and effectiveness tests, obtained a very good product development assessment. This means that the multi-application-based digital teaching materials developed are suitable for use in the learning process in elementary schools.

4. CONCLUSION

Based on multi-application-based digital teaching materials for research and development problem formulation in fifth grade elementary school, it can be concluded that content has an impact on students' ecological intelligence. This is shown by the results of the small group study used for the trial, the material content is higher than the group that only uses student textbooks. Ecological awareness can be formed along with the growth of ecological understanding and intelligence.

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