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Development of HOTS-Based Pocket Encyclopedia Books to Improve Science Literacy Culture in 21st-Century Learning

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Abstract: The rapid development of information and communication technology has influenced the field of education, which can be utilized in the learning process. This study aims to test the feasibility and effectiveness of the development of HOTS-based pocket encyclopedia books in improving the culture of scientific literacy in 21st-century learning. This study is a research and development (R&D) with the Borg and Gall model. The subjects of this study consisted of 66 fifth-grade elementary school students in Klaten Regency, Central Java, who were selected using random sampling techniques. Data collection techniques through surveys, tests, and observations. Data was analyzed quantitatively by evaluating the category, and then analyzed qualitatively. The results of the study indicate that the development of HOTS-based pocket encyclopedia books is proven to be valid, feasible, and effective in improving the culture of scientific literacy in 21st-century learning. The non-parametric effectiveness test (Kruskal-Wallis test) shows a significance value of 0.445. This indicates that HOTS-based pocket encyclopedia books developed are effective in improving the culture of scientific literacy in 21st-century learning. The use of this learning media can be an innovative strategy in creating active, fun, and interesting learning.

Keywords: pocket book, encyclopedia, high-order thinking skills, science literacy culture, science learning.

▪ INTRODUCTION

Success in learning activities is determined by several factors, including how a teacher applies learning innovations that make students more conducive to learning activities (Carrión-Martínez et al., 2020; Matthew et al., 2018; Ratheeswari, 2018; Zafar, 2019). In the field of education, advances in information and communication technology can be utilized in the learning process to improve its quality (Amutha, 2017; Bera, 2015). The reform itself can develop an innovative system that will equip all students with the skills needed to succeed in the 21st century (Heinrichs, 2016).

Several things need to be considered in the development of 21st-century learning, for example, the main task of teachers as learning planners, high-level thinking skills, the application of various learning approaches/models, and technology integration. In organizing education towards a standard educational process that includes planning, implementation, assessment of results, and supervision of the learning process (development of the pocket). In its implementation, teachers act as a crucial component in the success of the implementation of the education process (Meganingtyas et al., 2019). So, learning innovations created by teachers must meet several criteria in order to engage students (Cabreros, 2023).

The use of information and communication technology in the learning process can create effective, efficient, and engaging learning experiences (Huda, 2020; Kouser & Majid, 2021). A learning innovation must meet the innovative, applicable, and educational aspects. The innovative aspect is identical to novelty, is contemporary, and answers the demands of the new paradigm of education, especially the demands of 21st-

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century learning (Chaiyama, 2018). The applicative aspect means that it is easy to apply in various classroom conditions. The educational aspect emphasizes more on becoming a learner, providing facilities for students in learning activities so that learning outcomes are achieved in each basic competency (Twiningsih et al., 2024).

Learning in the 21st century requires every teacher to play an active role in developing a culture of literacy, strengthening character education, and developing 21st-century learning (Njui, 2017; Padmadewi et al., 2018; Singh, 2019). Literacy culture is a government movement to foster interest in reading in educational environments, both informal, formal, and non-formal (Khumsamart & Et, 2022; Nasreen et al., 2024; United Nations Educational, 2017). Literacy is also defined as a person's ability to apply knowledge in everyday life and make decisions about scientific problems (Arianto & Fauziyah, 2020). In measuring aspects of scientific literacy, PISA establishes three major dimensions, namely the science process, science content, and the context of science application.

Scientific literacy is one of the six skills needed in 21st-century learning. PISA 2018 defines scientific literacy as the ability of students to engage in science-related issues and scientific ideas as reflective citizens (Istyadji & Sauqina, 2023; Wang et al., 2019). Scientific literacy provides aspirations for the development of curriculum, learning materials, and assessment practices. If science materials and learning are facilitated with competence, students' scientific literacy will improve (Yao & Guo, 2018). Scientific literacy is a broad concept, the teaching of specific subject matter in science education that should contribute to the training of scientifically literate people (Bellová et al., 2018; Vieira & Tenreiro-Vieira, 2016).

The success of learning is determined by learning tools. Learning resources, as learning aids, play an important role in the learning process (Twiningsih, 2022). Learning resources can be interpreted as anything or power that can be utilized by teachers and students, either separately or in a combined form, for the interests of learning process activities to increase effectiveness, efficiency, ease, and enjoyment for the sake of learning continuity (Twiningsih et al., 2019). Books, as one of the learning resources, will have a more positive impact on student learning outcomes if presented more attractively. The attractiveness of a learning resource is determined by the syntax applied in the learning resource (Chan & Luk, 2022). Concerning the demands of 21st-century learning, good learning resources must be oriented towards aspects of communication, collaboration, critical thinking, and problem solving, as well as creativity and innovation (Indarta et al., 2021; Kızılaslan, 2019).

Higher Order Thinking Skills (HOTS) are defined as the extensive use of the mind to construct or discover something unique (Ahmad et al., 2018; Kaur et al., 2020; Zahroh, 2020). Higher-order thinking skills allow a person to apply new knowledge in new situations to generate potential answers. Higher-order thinking skills are thinking at a higher level than just memorizing facts and telling someone exactly the information as it is said (Kaur et al., 2020). The application of HOTS in learning begins with the analysis/C4, evaluation/C5, and creation/C6 stages.

HOTS is needed in science learning because many problems can be solved using HOTS skills (Ichsan et al., 2019). Students who are accustomed to problem-based learning that involves high-level thinking skills (analysis, evaluation, and creation) tend to be able to solve problems well in everyday life. This is because the activity of studying a problem is carried out more often by students so that they can solve problems with the background knowledge they have (Akben, 2020).

HOTS as a learning strategy can be implemented together with learning resources. Books as learning resources will be more interesting for students to read if presented completely, so that in the end, they can have a positive impact on students (Afriana et al., 2016). High-level thinking skills can increase students' interest in reading, which also has a positive impact on students' literacy skills. Meanwhile, the curriculum model needs to pay attention to three dimensions of the curriculum, which include content, process, and product, which are all interrelated. This cannot be separated from the aspects that teachers consider in implementing HOTS-based learning.

The role of teachers is crucial in improving students' thinking skills so that students can master and accept learning materials (Kumalasari et al., 2022). Teachers also need to adapt to ongoing innovation in creating meaningful learning. (Chusni et al., 2020). Kalyani dan Rajasekaran found that teachers who are not used to innovating in learning are one of the factors causing low active student participation (Kalyani & Rajasekaran, 2024). Therefore, teachers are required to have all the competencies that directly determine students' success in learning, such as mastery of material, learning methods, and learning media. The importance of HOTS-based teaching materials for students in learning success can bridge experience and knowledge (Afifah et al., 2021). The HOTS-based teaching materials are in the form of small pocket books.

Pocket books are books that are small in size, can be stored in a pocket, and are easy to carry anywhere. According to Nurmala et al. (2019), pocket books are books that are small and light in size, so that this book can be read anytime and are easy to carry anywhere. A similar statement was expressed by Hidrolaksmi & Rosyidah (2023), the use of pocket books has the advantage that they are portable, which can make it easier for students to learn. This pocket book has the advantage of being small in size and containing more concise material. In line with research conducted by Sinaga & Rakhmawati (2022), the effectiveness of learning using pocket media is categorized as very effective, with a percentage of 95%.

Along with the development of science and technology and HOTS ways of thinking, pocket books have experienced many variations of development. One of them is a pocket book that initially only had keywords and summaries to be equipped with an encyclopedia. Encyclopedias can make it easier for students to access the information they are looking for alphabetically (Faridah et al., 2014). Encyclopedias discuss topics of knowledge and cognitive development from various perspectives (Miller, 2016). The acquisition of complete knowledge becomes easier and more enjoyable, reliable, and transparent because it comes from several experts and is arranged in a hierarchical system (Kumala & Setiawan, 2019) so that it can improve learning outcomes, conceptual understanding, and student motivation.

Encyclopedias will be more preferred by students if they are contextual, so that they can relate the material taught to real-world situations by connecting knowledge and its application in their lives (Damayanti et al., 2018). By linking the learning process to student experiences, learning will be more meaningful, and students will be more productive and innovative (Poernomo et al., 2021).

Based on the results of initial observations in grade IV of elementary school, several problems emerged: during teaching and learning activities, many students were passive, lazy to read, and had low science literacy. Some students prefer to read in a quiet place, unable to concentrate in noisy conditions. The results of the analysis of books used in schools showed that the proportion of aspects of science literacy is not balanced. Students' interest in reading books can be seen from the way they look at the book visually. If the book or teaching material is thick and has a lot of material, students will be less interested in reading it. In line with the research conducted by Siregar et al. (2022), it was shown that learning using pocket book media is very interesting and effective in increasing student knowledge.

Reality shows that the books used by students for literacy activities are almost all thick books in general (Abaniel, 2021). This makes students less enthusiastic about reading books because the learning resources are less interesting (Ganapathy, 2016; Ro, 2013; Wilhelm, 2016). As a result, the content they read is not fully absorbed by them, which also determines their literacy (Wullur & Werang, 2020). In addition, many teachers still focus on memorization and passive learning. In contrast, active learning, such as critical thinking skills, problem solving, collaboration, expressing creativity, demonstrating leadership, and responsibility, is essential in the 21st century (Mangram et al., 2015; Roberts, 2019).

Pocket encyclopedia books are theoretically superior for improving scientific literacy because: (1) there is a combination of developed images and text, so that it attracts students' attention when reading and is easy to understand when learning to use science literacy-based pocket books; and (2) it is more contextual and appropriate to the student's environment, so that it helps students relate the material taught to real-world situations and encourages students to make connections between knowledge and its application in their lives. There are shortcomings in the design of encyclopedia pocket books, such as the importance of students having the ability and speed in reading, not being able to display animations or videos in pocket books, taking a long time to print pocket books, pocket books can also be lost and damaged if not stored properly (Afifah et al., 2021).

Several previous studies have shown that pocket books are interesting for students, so that they can be used in the learning process. Sakinah explained that the identification pocket book that was developed obtained an average of 87.89% of student learning outcomes, which was categorized as effective (Sakinah et al., 2023). Meanwhile, Ningsih and Suhardi (2021) argued that there was an increase in learning outcomes between students who used digital pocket books and those who did not use pocket books, so they were feasible and effective to be used as complementary teaching materials to help students during the learning process. This is reinforced by the results of research by Febriani et al. (2022), which proves that digital pocket book media based on Augmented Reality is feasible and practical to use for mathematics learning.

The development of HOTS-based pocket encyclopedia books was compiled by teachers to make it easier for students to understand better and learn scientific knowledge, as stated in the scientific literacy development guidebook (Kienhues et al., 2020; Purwati et al., 2018). This pocket encyclopedia book was compiled and adjusted to the objectives of science learning. The substance of it is based on HOTS inspired by the student books that are used as references by students (Al-harthy, 2019).In its implementation, it does not require large arithmetic operations. This book is provided by teachers for students as a learning resource. It can be used in the school environment or the family environment because it is designed not only to improve learning outcomes but also oriented towards improve reading culture, especially in the culture of scientific literacy (Babaci-Wilhite, 2017; Kilag et al., 2024).

The novelty of this research that distinguishes it from previous research is that the pocket encyclopedia book developed contains scientific literacy that can convey information well. This book is equipped with HOTS questions that aim to create learning that empowers students to develop their thinking skills and use their reasoning. The provision of these questions can be accommodated by providing a question package that contains various HOTS questions with aspects of scientific literacy skills on an ongoing basis. Based on the preliminary description, the development of a HOTS-based pocket encyclopedia book was carried out to improve the culture of scientific literacy.

▪ METHOD

This research used the Research and Development (R&D) method. According to Supartini et al. (2020), development research is a process used by researchers to develop and validate educational products. This development method consists of two main objectives, namely developing products and testing product effectiveness. The product developed is a HOTS-based pocket encyclopedia book to improve the culture of scientific literacy in science learning.

Participants

This study was conducted at an elementary school in Klaten Regency, Indonesia. The subjects of the study were 66 fifth-grade students. The sample was taken using a random sampling technique. Proportional random sampling is a method used to obtain samples by taking them randomly, which is proportional to the size of each sampling unit (Etikan, 2017; Mweshi & Sakyi, 2020).

Research Design and Procedure

The development stage refers to Borg and Gall, which consists of two main objectives, namely developing products and testing the effectiveness of products (Borg & Gall, 2003; Purba, 2024). The design of this research following the stages: Determination of the themes and core competencies to be developed

Scientific literacy culture activities are developed by enhancing literacy skills in subjects using the pocket science encyclopedia and reading strategies in science materials. The effectiveness of scientific literacy culture is implemented in the core learning activities stage, which encompasses the scientific process: identifying questions, explaining phenomena, and using scientific evidence. The development of HOTS-based pocket books. Scientific literacy culture activities are developed by enhancing literacy skills using the pocket science encyclopedia and reading strategies in all subjects. The stages of designing the HOTS-Based Pocket Science Encyclopedia Book are: 1) determining the theme and title of the book, 2) compiling the systematics of the book or its contents, and 3) collecting materials as sources of information and material for the encyclopedia book.

Meanwhile, the implementation of the use of pocket science encyclopedia books based on in improve the culture of science literacy in science learning was carried out by linking the substance of pocket science encyclopedia books with science learning in the classroom. The stages of implementing pocket science encyclopedia books based on HOTS in science learning activities are shown in Figure 1.

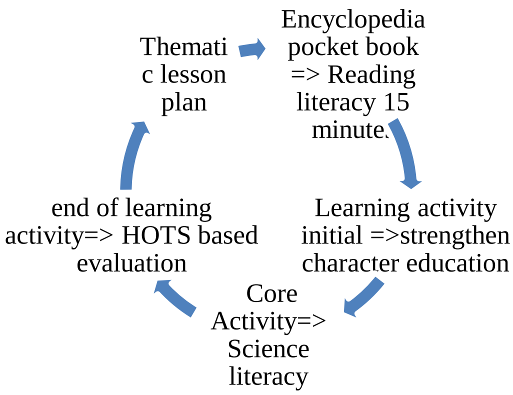

Figure 1. Stages of Implementation of HOTS-Based pocket encyclopedia books

The effectiveness of scientific literacy culture through reading culture can be implemented at the core learning activity stage which includes scientific processes including: in the initial activities of strengthening character education including the stages of identifying scientific questions, in the core activities explaining scientific phenomena obtained from scientific literacy culture activities through HOTS-based pocket encyclopedia books, and using scientific evidence from various trusted sources, then interpreted and reduced by students to find solutions to problems. Through this scientific evidence and findings, students can also develop their scientific literacy competencies in explaining scientific phenomena. Students' abilities in using scientific evidence and explaining scientific phenomena can be further developed through class discussion activities facilitated by teachers, where students express their opinions directly and write about their group's findings.

Instruments

Questionnaires, tests, and observation sheets were used as instruments to collect research data. According to Moser & Korstjens (2018), a questionnaire is a tool used to collect data consisting of a series of closed-ended questions that require responses from participants that are closed. The first instrument is a questionnaire on teachers' needs for HOTS-based pocket encyclopedia books. The second instrument is a questionnaire designed to measure the level of media and material feasibility. Validation questionnaires are also given to practitioners and students. The measurement of the questionnaire uses a Likert scale reference of 1-5 (Aithal & Aithal, 2020). The questionnaire grids can be seen in Table 1.

Table 1. Instrument grid

Type of Instrument	Aspect/Indicator	Number of Items
Material Expert	Accuracy of content, completeness, sequence, and motivation	10
Media Expert	Media quality, language, and layout	23
Teacher Response	Effectiveness, efficiency, relevance, usefulness	15
Student Response	Attention, activeness, understanding	13

The test instrument is in the form of multiple-choice questions that have passed the validation stage by three expert lecturers and a trial test process. The trial process is used to determine the validity, discrimination power, level of difficulty of the questions, and the reliability of the instrument. The scientific literacy test instrument is compiled based on the PISA science literacy assessment, which includes: (1) scientific processes, which include: identifying scientific questions, explaining scientific phenomena, using scientific evidence; (2) scientific content: understanding science; and (3) scientific context: solving problems (Shaffer et al., 2019).

Meanwhile, observations were conducted to determine the problems in the preliminary research (Hanif, 2020). The method used was non-participant and structured observation. The results of the observations contained what could be learned from the content of science literacy learning using HOTS-based pocket encyclopedia book media.

All instruments were tested for validity and reliability first. Validity testing is used to determine whether an instrument is valid or not. According to Taherdoost & Hamta (2017), validity is the level of items in an instrument reflecting the content that will be generalized by the instrument. In this study, to determine the validity of the test instrument, the product-moment correlation coefficient from Karl Pearson was used (Sugiyono, 2021). In addition, the instrument was also tested for reliability. Test reliability is the level of consistency of a test, namely the extent to which a test can be trusted to produce scores that remain unchanged even when tested in different situations (Pandey & Pandey, 2021). The formula used to measure the reliability of the instrument in the form of a multiple-choice test uses the Cronbach's Alpha formula.

Data Analysis

The use of techniques in analyzing data in this development uses quantitative and qualitative descriptive techniques. Quantitative analysis involves data from expert team validation (materials, media, and practitioners) to find out the average score, then analyzed qualitatively. All results in the form of comments, suggestions, and feedback are explained descriptively. Media feasibility categories according to Arikunto (2014). The data analysis of this study includes prerequisite and hypothesis tests processed using SPSS version 25. The prerequisite test includes normality and homogeneity tests. The normality test aims to determine whether the samples taken come from a normally distributed population or not (Creswell & Creswell, 2022). The normality test in this study used the Kolmogorov-Smirnov test with Lilliefors Significance Correction with a significance level of $\alpha = 5\%$. The homogeneity test was carried out using the Bartlett test with the chi-squared test statistic.

Meanwhile, the hypothesis test was used with the experimental design, namely by comparing the conditions before and after using the pocket encyclopedia (Before-After Design). Before-After Design is known as One Group Pretest-Post Test Design (Gower & Shanks, 2014). Before implementing the HOTS-based pocket encyclopedia book, students took a pretest to determine their initial abilities. After students understand the learning using the pocket encyclopedia book, students work on a post-test to find out the final results. The series of analyses is intended to test the questionnaire and data comprehensively and produce accurate data. This calculation uses the assistance of the IBM SPSS 25 program or application. The hypothesis test uses a non-parametric statistical test (Kruskal-Wallis test). The results of the test are then interpreted and used as a form of proof of the hypothesis that has been initiated by the researcher.

▪ RESULT AND DISSCUSSION

Development of HOTS-Based Pocket Encyclopedia Books

Teacher characteristics influence literacy climate in schools. Disciplinary literacy also suggests that learners may need different skills to participate and become literate in different content areas actively (Goldman et al., 2016; Spires et al., 2018). They also refer to disciplinary literacy as emphasizing the knowledge and skills possessed by those who create, communicate, and use knowledge in scientific disciplines. For example, reading a science text may require different skills than reading a fictional narrative. Students need to acquire media or reading sources to be literate in different subject areas (Lofthus & Silseth, 2019).

In this study, science literacy culture activities were developed through the development of pocket science encyclopedia books that led to HOTS-based learning. Science literacy culture activities were developed by improving literacy skills in subjects using pocket science encyclopedia books and reading strategies in all subjects, with the following stages: habituation, development, and learning. This habituation stage can be done by reading for 15 minutes before the lesson starts. The development stage can be done by providing various reading experiences, reading and writing activities, and fiction and non-fiction reading enrichment books. The learning stage can be done by implementing integrated literacy activities by adjusting the theme and subject matter. Habituation is a basic literacy practice that is the key to the success of increasing literacy (Awan, 2023; Hilton, 2016).

The pocket science encyclopedia book is an electronic book that contains science material at the elementary school level. The use of this book is adjusted to the science literacy skills process, which consists of (1) scientific processes, which include: identifying scientific questions, explaining scientific phenomena, using scientific evidence; (2) science content: understanding science; and (3) science context: solving problems. Meanwhile, the use of the pocket science encyclopedia book is carried out by opening the lesson, conveying learning objectives, and conveying learning perception. The following is the appearance of the material in the HOTS-Based Pocket Encyclopedia Books, which is presented in Figure 1.

Figure 1. Material in HOTS-Based pocket encyclopedia books

The material developed relates to the human digestive system. In the initial stages, the pocket encyclopedia encouraged students to recall the digestive system. Through the stimulation of images and food, students would immediately think critically about the process of digesting food, and would be enthusiastic about exploring the digestive system.

Students observed a video explaining the human digestive process by scanning the provided barcode.

Critical and creative thinking skills and analysis through the pocket science encyclopedia book are one of the expected outputs from the activity of creating a culture of scientific literacy. With a culture of scientific literacy, it is expected to improve students' critical, creative, and analytical thinking skills. The habit of reading culture increases students' curiosity to solve a problem, so they are required to have high-level thinking skills as well, and ultimately, the important role of HOTS is essential. An example of the student worksheets' display is presented in Figure 2, which stimulates higher-order thinking skills (HOTS).

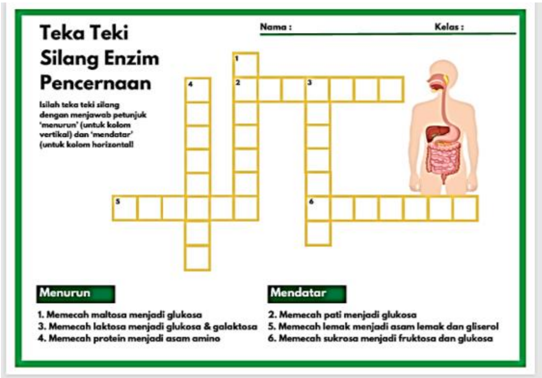

Figure 2. Display of students' worksheets in HOTS-Based pocket encyclopedia books

The student's worksheet section stimulates students' HOTS thinking to recall the material related to enzymes in the digestive system. Students felt challenged and curious to solve each question in the puzzle. There were several questions with answers that can be written horizontally or vertically according to the number sequence in the question. Learning that implements HOTS must be characterized by the transfer of knowledge, critical and creative thinking, and problem-solving that includes facts, concepts, procedures, and metacognition learning process (Liline et al., 2024; Ragab et al., 2024).

Next, a validation process was conducted to assess theoretical and practical feasibility (May et al., 2018; Ssegawa & Muzinda, 2021). The pocket science encyclopedia was validated by subject matter experts, media experts, and practitioners. The purpose of the feasibility test was to obtain responses and assessments from subject matter experts, media experts, and practitioners (teachers and students). The data obtained was then analyzed, and product revisions were made based on suggestions. The summary of the average validation results from subject matter experts is presented in Table 1.

Table 1. Summary of subject matter expert assessments

Instrument Type	Average Value
Material Expert	4
Media Expert	3
Teacher Response	3.5
Student Response	4
Total Score	14.5
Percentage	90.62%

Based on the results of the expert validity test, the pocket science encyclopedia obtained a total score of 12 out of a maximum of 16, with an average of 3.625. This assessment indicates that, in general, all assessed instruments fall into the very suitable category for use. The material expert's assessment concluded that the pocket science encyclopedia adequately explained and illustrated the learning material for students.

The expert recommended that the pocket science encyclopedia should include learning outcomes and a flow of learning objectives for the topic of the human digestive system at the beginning of the section. This sentiment was echoed by Sofianti et al. (2024) and Surya & Syahputra (2017) who stated that the encyclopedia's design should be based on learning objectives and material descriptions that align with core and basic competencies. Furthermore, the media expert suggested improving the layout of the images to be more proportional to the size of the book and ensuring an appealing perspective. Teachers, acting as practitioners, also suggested improving the layout of the images and illustrations and correcting any spelling errors. According to (Ferretti, 2017; Gerhard et al., 2016), an image or photograph can provide a realistic depiction of an actual object, providing a more vivid and precise learning experience than words, thereby stimulating students' thinking skills.

Before the product was piloted, a pilot test of the instrument was conducted on 42 fifth-grade students at a public school in Klaten Regency. The scientific literacy test instrument included: (1) the science process, which includes: identifying scientific questions, explaining scientific phenomena, and using scientific evidence; (2) science content: understanding science; and (3) science context: solving problems (Shaffer et al., 2019). The data obtained were analyzed using SPSS 29 before being implemented in learning to measure validity and reliability. An instrument should be measured using corrected item-total correlation and product-moment with a 5% significance level (Mohamad et al., 2015; Zijlmans et al., 2019). The significance test was conducted by comparing the calculated r-value and the r-table for df = n-2, in this case, n is the number of samples, with an alpha of 0.05. Validity testing at the trial stage with a sample of 42 students, then df = 42-2 = 40 with an r table value of 0.312. This means that if the calculated r > r table, namely 0.312, the question can be said to be valid. Table 2 shows the results of the validity value of each question item.

Table 2. Results of the scientific literacy validity test

No.	R-Calculation	R-Table	Description
1	0.680	0.312	Valid
2	0.760	0.312	Valid
3	0.539	0.312	Valid
4	0.335	0.312	Valid
5	0.680	0.312	Valid
6	0.760	0.312	Valid
7	0.475	0.312	Valid
8	0.451	0.312	Valid
9	0.691	0.312	Valid
10	0.372	0.312	Valid
11	0.749	0.312	Valid
12	0.461	0.312	Valid
13	0.423	0.312	Valid

14	0.483	0.312	Valid
15	0.749	0.312	Valid
16	0.539	0.312	Valid
17	0.485	0.312	Valid
18	0.483	0.312	Valid
19	0.549	0.312	Valid
20	0.335	0.312	Valid

Based on the validity test, all 20 questions were declared valid. This means that the r count > r table, so all questions are valid (Ardini, 2023; Sofianti et al., 2024). Furthermore, the reliability test results were obtained in the Cronbach Alpha column of 0.732. The Cronbach-Alpha value is based on calculations at the variable level, consisting of 20 valid questions. The value of 0.732 is above the minimum limit of 0.70, so it can be concluded that the scientific literacy test on the human digestive system is included in the reliable category. Reliability in this study reflects the extent to which the instruments and procedures used are consistent and reliable in measuring the variables studied (Pratiwi & Wiarta, 2021).

Table 3. Results of the science literacy reliability test

Cronbach's Alpha	Number of Items
.732	20

The pocket science encyclopedia product, which has been validated by the validator, was declared suitable for testing. The product was tested using a questionnaire developed by the researchers, which collected responses from teachers and students. The detailed results of the teachers' responses are presented in Table 4.

Table 4. Teacher response assessment

Aspects	Average value
Learning design	4.6
Quality of evaluation questions	5
Operational	4.25
Visual communication	5
Content appropriateness	4.57
Media usefulness	4.43
Percentage	**92.83%**

Based on the results of teacher responses to the pocket science encyclopedia book product developed, it received a percentage score of 92.83%. It was included in the category of appropriate, and no revisions were required. This proves that science teachers consider the pocket science encyclopedia book product appropriate.

Table 5. Student response assessment

Aspects	Average value
Media appearance	4.6
Material quality	5

Evaluation questions	4.25
Operational quality	5
Model quality	4.57
Media usability	4.43
Percentage	**92.83%**

Based on the results of student responses, it can also be seen from the trial calculation that obtained a score of 95.57% with a very appropriate category. Students noted that the structured presentation of the material and the many practical examples improved their understanding of scientific literacy. These results indicate that the pocket science encyclopedia book product developed is suitable for use. The encyclopedia book product can be used as a teaching material for teachers in elementary schools. A similar opinion was expressed by Aditia (2022) that the digital pocketbook based on inquiry is suitable for use to improve the scientific literacy skills of sixth-grade elementary school students in Toroh District. In line with the results of these studies (Amri, 2023; Suprianti, 2020) revealed that technology-based media can have a positive impact on students.

The Effectiveness of HOTS-Based Pocket Encyclopedia Books

Pretest and posttest scores were calculated to determine the effectiveness of improving students' literacy culture using the gain formula. The normalized scores were interpreted using the gain level criteria (Coletta & Steinert, 2020; Hake, 1999). The average gain scores for the experimental and control classes are shown in Figure 3.

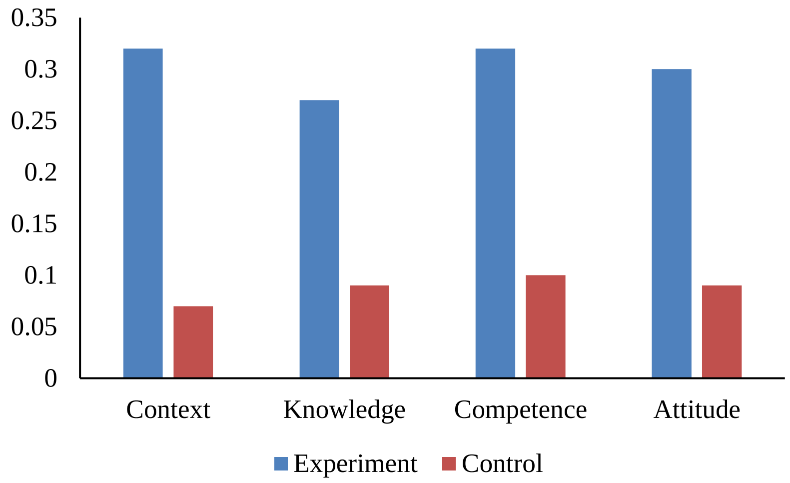

Figure 3. N-Gain results for the experimental and control class scores

Based on Figure 3, it can be seen that the average increase in the maximum N-gain score occurred in the experimental class at 0.30 compared to the control class at 0.09 with low criteria. The implementation of HOTS-based pocket encyclopedia books in fifth-grade science learning can provide an effective contribution to improving students' scientific literacy culture.

The N-gain value data of improving students' scientific literacy culture was analyzed using prerequisite tests (normality and homogeneity) so that further tests could be carried out to test the effectiveness of HOTS-based pocket encyclopedia books in fifth-grade science learning in improving students' scientific literacy culture. The results of the normality and homogeneity test analysis of the N-gain science literacy culture of the experimental class obtained a value of 0.200 (p>0.05), which means the data is normally distributed, and the control class obtained a value of 0.030 (p>0.05), which means the data is not normally distributed.

Furthermore, in the homogeneity test results, both classes obtained homogeneous values, so it was continued with non-parametric statistical tests. Hypothesis testing was carried out using the Kruskal-Wallis test. The Kruskal-Wallis test was carried out to compare the learning outcomes of two or more classes when the data did not meet the assumptions of normality and homogeneity.

According to Liang et al. (2019), if both data sets are normally distributed, the mean difference test is carried out using the t-test (independent t-test). However, if one or both data sets are not normally distributed, then the U-test (Mann-Whitney Test) is used. Based on the findings in the final scores of the experimental class, it is also normally distributed with a sig-value of 0.070. However, the final ability of the control class is not normally distributed with a sig-value of 0.024. Meanwhile, the results of the pre-test homogeneity test for both classes showed a sig-value of 0.262, which means the data is homogeneous. However, the results of the post-test homogeneity test for both classes are not homogeneous because the sig-value of 0.030. The initial ability was tested using the t-test because both datasets were normally distributed, but the final ability was tested using the U-test because there was one dataset that was not normal.

A similar thing also happened in the study of Achmad & Suhandi (2017), where the pretest score of the experimental group was a sig. 0.200 (normally distributed) and the control group with a sig. 0.013 (not normally distributed), so the Mann-Whitney test was conducted. There is an element of similarity in continuing the test, using a non-parametric statistical test, because there is some data that is not normal or homogeneous. Study of Achmad & Suhandi (2017) and Dwi Cahyani et al. (2024) used the Mann-Whitney Test, while this study used the Kruskal-Wallis test. This is because both tests are used to compare two or more independent groups that do not require the data to be normally distributed (Okoye & Hosseini, 2024).

The test results show that the Kruskal-Wallis value is 1.621 with a degree of freedom (df) of 2, and a significance value of 0.445. Because the significance value is greater than 0.05, it can be concluded that there is no statistically significant difference between the learning outcomes of students in the two classes. The results of Kurucova et al. (2018) also showed that the software report included a p-value of 0.579. Because p is greater than 0.05, the null hypothesis cannot be rejected, and the observed difference is not significant. The Kruskal-Wallis test confirmed that each group did not differ significantly in terms of the pre-test scores achieved. Similar results were expressed by Niedoba et al. (2023) that the results of the Kruskal Wallis test with degrees of freedom (k = 3) with a p-value = 5.991, so it can be assumed that the harvest yields of individual particle size fractions, regardless of the amount of added water and system capacity, are subject to the same distribution. Similar results were also expressed by Azhary et al. (2020) that for classes Y and Z, there were no significant differences (p > 0.05; p = 0.809).

Thus, the achievement of student learning outcomes is relatively equal between the two classes, although it shows abnormal results. This means that the HOTS-based pocket encyclopedia books in science learning for grade V in improving students' science literacy culture have uniform effectiveness in the class. This shows that the development of the pocket encyclopedia book can improve students' reading culture, so that it has a positive impact on the development of literacy culture, especially science literacy culture. Students' high-level thinking skills or HOTS increase, making it easier for teachers to prepare assessment evaluations as instruments to measure the success of learning activities.

Good learning must be inspired by HOTS-based learning, as it forms the character of students equipped with critical thinking and ultimately has a positive impact on literacy activities or reading culture. HOTS-based learning requires students to be active in learning so that teachers act as facilitators, meaning that teachers give scaffolding when students have difficulty solving the problems. Related to this, Erikson and Erickson also revealed three problems with learning outcomes, namely (1) the use of learning outcomes that depend on an interpretive framework, (2) the problem of educational goals that cannot be expressed through learning outcomes, and (3) the risk that learning outcomes can be used as the upper limit of students' ambitions. This has been emphasized in Uğur & Koç's research that principals are advised to be able to provide policies that can encourage teachers to consider student comfort in the learning process (Uğur & Koç, 2019).In addition, teachers also need to increase their creativity in order to create meaningful learning (Kostiainen et al., 2018; Selkrig & Keamy, 2017).

Learning by integrating scientific literacy culture through HOTS-based pocket encyclopedia books can be implemented at the learning stage. The effectiveness of scientific literacy culture through reading culture can be implemented at the core learning activity stage, which includes scientific processes, including identifying scientific questions, explaining scientific phenomena, and using scientific evidence. In core learning activities in the classroom, a teacher can integrate reading culture by linking themes or lessons with learning materials during core learning activities. The scientific literacy culture that is integrated with core learning activities must refer to solving problems related to the subject matter, so that there is a relationship between the development of a scientific literacy culture with core competencies and basic competencies that teachers will achieve. According to Falloon (2020) and Georgiou & Kyza (2023), it is emphasized that the application of a scientific literacy culture is something that is expected and is a crucial part of increasing knowledge competency in linking general knowledge. In addition, science can be a provision and strength in facing global challenges in the 21st century, which have complex levels of problems (Coque et al., 2023; Stein et al., 2022), such as global warming, economic crisis, energy crisis, environmental pollution, and problems that occur between various groups.

Integration and synchronization between classroom learning activities by creating a culture of scientific literacy through the pocket science encyclopedia book will have a positive impact on the Strengthening of Character Education (PPK) of students and when they solve the HOTS problems, so students can obtain learning outcomes according to the Minimum Completion Criteria assessment which is the standard for achieving competency. The same thing was expressed by Afifah et al. (2021) and Kumalasari et al. (2022), that students' responses were very interested in the development of science literacy-based pocket books. The results of Singh's (2019) study also support this finding that the products developed can improve science literacy skills. This is evidenced by the learning outcomes of students who achieve very high completeness.

▪ CONCLUSION

This study concludes that the development of HOTS-based pocket encyclopedia books is proven to be valid, feasible, and effective in improving the culture of science literacy in 21st-century learning. The results of the product feasibility test, validated by media experts, materials, and practitioners, are included in the feasible category. Furthermore, the results of the Kruskal-Wallis test showed a significance value (sig. 2-tailed) of 0.445. This shows that the development of pocket encyclopedia books can improve students' reading culture, so that it has a positive impact on the development of literacy culture, especially science literacy culture in 21st-century learning.

These findings indicate that the HOTS-based pocket encyclopedia book development tool can significantly improve the learning experience. This is a valuable insight for educators who continue to seek innovative methods to engage students and improve learning outcomes. From a theoretical perspective, this study contributes to the existing literature by providing empirical evidence on the effectiveness of HOTS-based pocket encyclopedia books in elementary education. Regarding policy implications, the results of this study recommend integrating learning tools into the education curriculum. This requires education policymakers to consider investing in and supporting technology-based learning tools in the classroom, particularly at the elementary level.

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