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Media "Exploding Box" IPAS Differentiated Based on Ethnoscience: A Solution to Optimize Science Literacy

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Abstract

Purpose: This study aims to develop and assess the feasibility of ethnoscience-based *exploding box* learning media that incorporates batik activities to enhance science literacy among elementary school students.
Methodology: The research applies a Research and Development (R&D) approach using the ADDIE model (Analyze, Design, Development, Implementation, Evaluation), though limited to the development phase. Data were collected through observation, interviews, documentation, and questionnaires. Qualitative analysis was conducted using feedback from media and content experts, while quantitative data were obtained from expert validation questionnaires.
Results: The resulting *exploding box* media integrated into IPAS learning on the topic of changes in the states of matter for fourth-grade students received an average validation score of 88.23% from media experts and 95% from material experts, both categorized as "very worthy.
Applications/Originality/Value: Rooted in the ethnoscientific context of Surakarta's batik tradition, this media supports differentiated instruction by catering to visual, auditory, and kinesthetic learning styles. It serves as a culturally responsive innovation that promotes early science literacy through engaging and contextually relevant learning experiences.

Introduction

Indonesia has a very rich cultural diversity with more than 250 ethnic groups (Dokhi et al., 2016). However, cultural diversity can fade due to the influence of globalization (Azizah & Premono, 2021). This has become a unique challenge in the world of education in Indonesia. Currently, the curriculum in Indonesia is the Merdeka curriculum, and known as Merdeka Belajar. Merdeka Belajar strives to develop the spirit and body of students through culture (Pangestu & Rochmat, 2021). Students can develop interests and learning experiences through the influence of culture in the learning process, as stated by Mahartini (2019) culture-based learning is an effort to create a learning environment and design learning experiences that integrate cultural elements into the learning process. Emphasizing culture in learning can raise students' awareness of their own culture (Rahmawati, 2018). This is in line with Arfianawati et al. (2016) who found that the use of local knowledge in learning is very important because it is related to daily life. However, Shidiq (2016) notes that learning in schools is often not yet connected to everyday life, including the culture present in the community environment.

The Organization for Economic Cooperation and Development (OECD), which conducts the Programme for International Student Assessment (PISA), stated that the results of the 2022 PISA assessment showed an improvement in the ranking of science literacy by 6 positions. However, despite the improved ranking in science literacy, Indonesia's score decreased by 13 points (Kemendikbudristek, 2023). The average PISA score in the field of numeracy literacy in Indonesia is 366 points, with a difference of 106 points from the world average score of 82 percent (OECD, 2023).

Scientific literacy encompasses an individual's capacity to apply existing knowledge, construct new understanding through experiential learning, and offer logical explanations grounded in the scientific method. It involves drawing conclusions from empirical evidence and fostering reflective thinking to address problems associated with scientific topics (Fitria & Indra, 2020). Every individual is constantly faced with questions about life that require information and scientific thinking to make decisions related to personal and community interests in utilizing the potential of natural resources such as air, water, and the environment (Hamna & Ummah BK, 2022). Based on the test results, science literacy in Surakarta remains relatively low which is why many students struggled to answer questions, even at levels 1 and 2 (Nur'Aini et al., 2018). The lack of science literacy is often caused by the suboptimal use of learning media during the learning process. This is in line with Khery & Khaeruman's (2016)_Research indicates that the integration of interactive multimedia significantly enhances students' science process skills and scientific attitudes. When concrete objects are utilized to visualize the material, elementary school students are able to grasp lessons more swiftly. According to Jean Piaget's theory of cognitive development, children in elementary school are in the concrete operational stage, during which they require tangible objects to facilitate their learning experiences (Istiqomah & Maemonah, 2021). Latip & Permanasari (2016) explain that multimedia can enhance science literacy skills because it allows for in-depth learning and the application of knowledge in real, new, and different situations.

Learning media are any tools that can be used as a means of delivering information and are aimed at achieving learning objectives (Djamarah & Zain, 2020). In addition, learning media is one of the efforts to meet the learning needs of each individual in the learning process, this type of learning is called differentiated learning. Differentiated learning is a teaching method that focuses on students' learning needs, including learning readiness, learning profiles, interests, and skills (Aprima & Sari, 2022). In the learning process, it often happens that teachers do not accommodate the learning style needs of students. Many teachers still treat students uniformly in the learning process to avoid jealousy among students and to ensure equal rights for children. However, differentiated learning to develop students' potential certainly cannot be separated from the challenges that will arise in the field. They believe that differences in handling can cause jealousy among other students because one student receives special attention (Mulyawati et al., 2022). The study revealed a notable phenomenon in classroom learning, where teachers often adopt a one-size-fits-all approach, neglecting to accommodate individual students' learning styles. Instruction tailored to students' specific learning preferences is deemed more effective than conventional teaching methods, as it significantly enhances students' motivation to engage with science and related subjects (Demir, 2021). Differentiated learning needs to be developed in learning communities to provide instruction that meets individual needs and is capable of adapting to the demands of the 21st century (Nawati et al., 2023). Therefore, learning media is greatly needed by students to help them understand abstract lesson materials with the aid of real objects and can enhance science literacy through an ethnoscience approach or local wisdom.

Ethnoscience is an ethno-study field that aims to understand how indigenous communities perceive nature. The ideology and philosophy of life embraced by the indigenous community play a crucial role in their survival (Fahrozy et al., 2022). One element that is suitable for integration in the science learning process is local potential which is the advantage of each region (Handayani et al., 2019). The integration of ethnoscience into society is prominently illustrated through local wisdom, exemplified by batik-making activities, where the community derives design motifs from nature. Batik represents a vibrant cultural heritage in Indonesia, with the Laweyan district in Surakarta recognized as the heart of batik production. However, this rich indigenous knowledge has not been adequately woven into the educational framework, particularly within Integrated Science and Social Studies (IPAS) lessons. Educators have yet to fully optimize the incorporation of local knowledge into their curricula (Purnani & Mulianingsih, 2020). The phenomenon occurring among elementary school students is the lack of understanding of the scientific process found in local wisdom, such as in the batik-making activity. The batik-making activity has several stages that encompass the scientific process in its application.

This scientific process is particularly found in the material on the changes in the state of matter. As per Kristyowati & Purwanto (2019) Science literacy in elementary school students can be optimized through learning that integrates it with local wisdom in the surrounding environment and is supported by learning media that accommodates the learning needs of the students. Certainly, the integration of the science process into local wisdom can be an alternative to IPAS learning, which will be related to the improvement of science literacy skills Kriswanti et al (2020) explain that ethnoscience can be integrated into the development of learning tools as an effort to improve science literacy.

As per the study results by Malik et al., (2024) one of the learning models that can enhance science process skills in IPAS learning is based on local wisdom, so it is hoped that this activity will become one of the options in the learning process. Learning media must be chosen carefully, considering the material to be taught and the characteristics of the learners. This will ensure that the learners can actively participate in the learning process (Kosim et al., 2024). However, the reality shows that teachers do not present media or supporting tools as visualizations for some materials in IPAS learning, which causes students to be unmotivated to learn, resulting in low enthusiasm and response from the students. The absence of media that supports the learning process causes students to feel bored when receiving material (Suwarti et al., 2020). Based on this phenomenon, the science literacy skills of elementary school students are not being optimized well.

Studies related to the development of the exploading box media have been previously studied. The previous study that developed the exploading box media was conducted by Tirtoni et al., (2019) which developed a smart exploading box media based on deep dialogue critical thinking to face the era of the 4.0 industrial revolution. Based on this study, a smart exploading box learning media was produced to enhance critical thinking and life skills in students to face the 4.0 industrial revolution. Another study was conducted by Lova (2021) This study focuses on developing an ethnoscience-based exploading box learning media integrated with QR code technology for thematic learning in fifth-grade elementary school. The aim is to enhance students' understanding of the material and improve learning processes and outcomes. Given the identified needs and challenges in current educational practices, the researcher aims to create differentiated exploading box learning media for the IPAS subject, incorporating local wisdom and innovative design to cater to various student learning styles.

Based on the background and problems above, researchers need to develop exploading box learning media in differentiated IPAS subjects with ethnoscience-based as an effort to require the learning needs of students and conduct learning with a local wisdom approach that has an innovative and creative design to optimize science literacy in grade IV students. Therefore, based on the needs of students, classroom teachers and based on previous research, researchers will conduct research and development entitled **"Media "Exploading Box" IPAS Differentiated Ethnoscience Based: A Solution to Optimize Science Literacy".**

Method

This study uses a type of study and development or is referred to as Research and Development. As per Fayrus & Slamet (2022) Research and Development (R&D) is a method used to create specific products and test their effectiveness. The development model used in this study is the ADDIE model. ADDIE is an instructional design that focuses on individual learning (Hidayat & Nizar, 2021). The ADDIE model has five steps: Analysis, Design, Development, Implementation, and Evaluation. However, in this study, the studies limited themselves to the development stage only. The stages of the ADDIE model in this study are as follows:

Analyze Stage

This analysis stage aims to identify possible causes of gaps in learning performance. To complete this stage, teachers must be able to determine instructions that can address these gaps, set the necessary levels to close the gaps and offer strategies based on empirical evidence that demonstrate the potential for learning success (Hidayat & Nizar, 2021). The analysis stage in this study was conducted by distributing a needs analysis questionnaire to teachers and students of SD Negeri Laweyan and observing during IPAS lessons. Then, the needs for the design of the exploading box media were determined based on the results of the needs analysis of the teachers and students.

Design Stage

In this study, the design stage involves detailing the media that will be developed. The stages of designing the exploading box media include: 1) selecting learning materials that align with learning outcomes, 2) creating a flowchart for the exploading box media that outlines the steps for making the exploading box media, 3) designing the exploading box media using the Canva application, 4) printing the design created using the Canva application in the form of stickers.

Development Stage

In the development stage, there are two main objectives: to produce a product and to select the best product. At this stage, the design from the previous stage is realized into a medium ready for implementation (Rachma et al., 2023). The development stage of this study involved the creation of an exploading box media that was based on the previously created design. The exploading box media will be subjected to a validation test by subject matter experts and media experts to evaluate its feasibility.

The data collection methodologies employed in this study include observations, interviews, documentation, and questionnaires. The fourth-grade teacher at SD Negeri Laweyan was interviewed, and the IPAS lessons for fourth-grade students were observed. Media validation was conducted by Mr. M.A., a lecturer at PGSD UMS with expertise in media, while material validation was performed by Ms. A.D., a lecturer at PGSD UMS, specializing in science. The product underwent validation twice. Four assessment aspects were utilized in the media validation testing: graphic quality, media presentation, content quality, and linguistic accuracy. Simultaneously, the material validation testing was assessed through three parameters: content feasibility, presentation feasibility, and linguistic appropriateness. The documentation relevant to this investigation pertains to the media product known as the exploading box. The data analysis technique employed in this development is qualitative, based on the evaluation results of validation sheets completed by media and material experts. Additionally, quantitative data was derived from the assessments of the validation sheets by these experts. Questionnaire assessment criteria will be applied to analyze the collected data (Haking & Soepriyanto, 2019), which is presented in Table 1.

Table 1. Survey assessment category

Criteria	Score
Very worthy	4
Worthy	3
Less worthy	2
Not worthy	1

Sources: (Haking & Soepriyanto, 2019)

Filling out the questionnaire with scores and criteria based on the presented Table 1, followed by scoring by media and material experts using the Likert scale formula adapted from (Afriyanti et al., 2018), those are:

$$x_i = \frac{\Sigma s}{S_{max}} \times 100\%$$

Explanation:
S_{max} = Maximum score
$\sum s$ = Total score
x_i = Eligibility score

Next, the feasibility results will be obtained based on the feasibility scale adopted and modified by (Haking & Soepriyanto, 2019) which is presented in Table 2.

Table 2. Media eligibility category

Criteria	Percentage Score
Very worthy	75 % ≤ xi ≤ 100 %
Worthy	50 % ≤ xi < 75 %
Less worthy	25 % ≤ xi < 50 %
Not worthy	0 % ≤ xi < 25 %

Sources : (Haking & Soepriyanto, 2019)

Result and Discussion

This study develops a learning media that is rooted in ethnoscience and differentiated through batik activities in Integrated Science (IPAS) instruction, specifically focusing on variations in states of matter. The media takes the form of an exploading box, which is a cube-shaped educational tool consisting of two box sections, each with four sides. Designed for fourth-grade elementary school students, this exploading box media addresses the topic of changes in matter and integrates the local wisdom of Surakarta, particularly batik. To facilitate the construction of the exploading box media, the researcher utilized a flowchart to organize the development process. This flowchart served as a guiding framework for designing the exploading box media. Subsequently, the researcher employed the Canva application to create the visual design, as depicted in Figure 1.

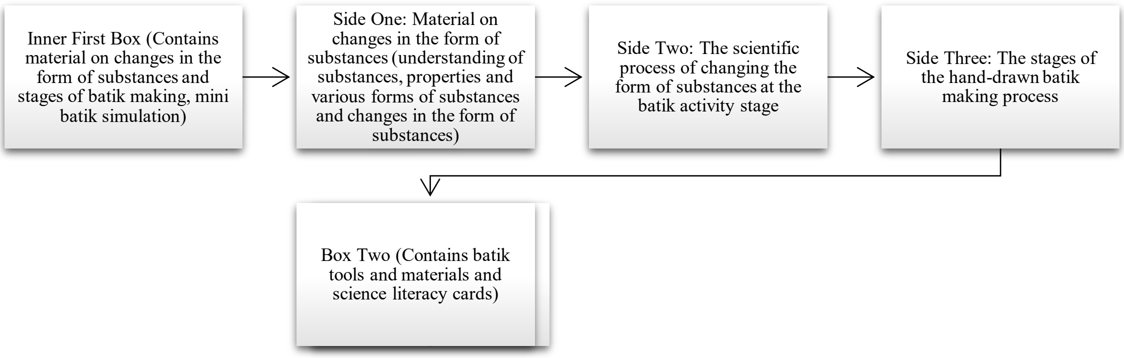


Figure 1. Flowchart media *exploading box*

The exploading box media serves as a learning resource that emphasizes Integrated Science and incorporates the local wisdom of Surakarta, specifically focusing on batik. The content centers on the variations in states of matter. This media comprises two main components. The first box introduces general concepts related to changes in states of matter, outlines the stages of creating batik, and provides resources for students to engage in a simple batik simulation. The purpose of the exploading box media is to enhance scientific literacy by integrating IPAS material with local wisdom (ethnoscience). Illustrates the external appearance of the exploading box media prior to its revision can be seen in Figure 2.

Transalation:
1. The ethnoscience of batik
2. IPAS differentiated

Figure 2. Box exterior view (before revision)

The exploding box media is designed as a differentiated learning tool tailored to accommodate diverse student learning styles. To achieve this, the developers created the exploding box media with content presented on each side in an engaging format that includes images, text, and interactive activities. This approach allows learners to study as per their individual preferences and potential. Furthermore, the exploding box not only promotes active engagement but and enhances conceptual understanding while optimizing students' science literacy skills throughout the learning process. The components of the exploding box media are elaborated upon below, aligned with the various learning styles of the students as depicted in Table 3.

Table 3. Details of learning style components in the exploding box media

Learning style	Components in the Media Exploding Box	Figure
Visual	Explanation of the material in the form of a short text accompanied by images and elements.	Available in figure 3a
Auditory	Equipped with a QR code that contains a video.	Available in figure 3b
Kinesthetic	Presented an interactive activity, namely a mini batik simulation.	Available in figure 3e

The exploding box media was meticulously designed by the researcher in accordance with the established design plan, which was developed using a flowchart. The framework for the exploding box media was constructed by preparing the necessary instruments and materials. A yellow board was utilized to select the primary materials for the exploding box media. Following this, the Canva application was employed to facilitate the development of the media. The design outcomes from Canva were saved in PDF format and subsequently printed as stickers. These printed labels were then affixed to each side of the exploding box media. The exploding box media consists of two boxes, the outer box measures 30 cm x 30 cm, while the inner b[illegible]asures 25 cm x 25 cm. Illustrates the interior section of the initial box of the exploding box media prior to its r [3b] [illegible] presented in Figure 3.

Transalation:

3a

1. What is substance?
2. Matter is money that has mass and occupies space.
3. Types of Substance Forms

4. Melting is a change in the form of objects from solid to liquid.
5. Freezing is a change in the state of objects from liquid to solid.
6. Vaporizing is a change in the form of liquid to gas.
7. Condensing is a change in the form of objects from gas to liquid
8. Sublimation is a change in the form of solid objects into gas
9. Crystallizing is a change in the form of gas to solid.
10. Properties of Substances
11. Solids
12. Solids have a fixed shape.
13. Solids have a fixed volume.
14. Liquid substance
15. Its shape will change according to the place (not fixed).
16. Occupies space.
17. Fixed volume.
18. Gaseous substances
19. Gas has a shape that is not fixed.
20. Gas presses in all directions.
21. Cannot be touched but can be felt.

3b

1. The science process of changing the form of substances in the batik process
2. Thawing
3. Batik wax (malam) is heated on a stove or furnace until it turns from solid to liquid. This liquid wax is used to draw batik motifs on the cloth. The process of changing the form of this substance is called melting (solid to liquid).
4. Yawning
5. The fabric that has been coated with wax is dipped into the dye. When finished, the cloth is rinsed with hot water so that the wax attached to the cloth can be removed. This wax will re-melt in hot water, and the boiling water will undergo evaporation (liquid to gas).
6. Freezing
7. The change of form from liquid to solid is called freezing.
8. In the batik process, after the wax that has been applied to the cloth has cooled, the wax on the cloth will harden again (become solid).

3c

1. The Stages of Batik Making
2. Making Patterns
3. A batik pattern consists of a main picture and a supporting picture. The filling pattern is drawn while making batik with wax.
4. Dyeing process of the fabric
5. Liquid wax is used with canting to draw the main pattern (nglowong), fill the pattern image (ngisen-iseni), and cover the part of the fabric that will not be colored (nembok).
6. Fabric coloring
7. After the mencanting process, the batik cloth that has been drawn using canting will be colored.
8. Locking color
9. After coloring the fabric, the next step is to lock the color using waterglass.
10. The wax is removed from the cloth by soaking it in hot water until the wax is released.
11. Washing fabric
12. The cloth is washed until clean from the remaining wax, then dried in the shade, not exposed to direct sunlight.

3d

1. Mini simulation of batik making

Figure 3. View of the interior design of the first box

Usage instructions accompany the exploading box media to facilitate its application by both students and instructors. To enhance the effectiveness of the media, the researcher included detailed instructions for use. Furthermore, the researcher developed "science literacy cards" aimed at improving the science literacy skills of fourth-grade students. These cards are designed not only to deepen students' understanding of the material related to changes in the states of matter, which is integrated through batik activities, but and to foster their overall science literacy abilities. The science literacy cards are presented in a landscape format, measuring 7 cm x 9 cm. The science literacy card before revision is presented in Figure 4.

Translation:

1. Rani and her friends are participating in batik making activities at school. In the first stage, they have to heat the wax (candle) so that it becomes liquid so that it can be easily used to cover parts of the fabric that will not be exposed to dyes. When the wax is heated, what changes in form does it undergo?
2. Candle melts into gas
3. Candle melts into liquid
4. The wax freezes into a solid
5. Candle evaporates into gas
6. Science literacy cards based on ethnoscience

Figure 4. Display of the science literacy card

The subsequent phase involves assessing the exploading box media developed by the researchers, with a particular focus on media validity testing, which is a crucial aspect of this evaluation process. This assessment covers various dimensions, including graphic quality, media presentation, content accuracy, and linguistic elements. To ensure a thorough evaluation, Mr. M.A., a distinguished lecturer from PGSD UMS with extensive expertise in the field, was appointed by the researchers to serve as the media expert for the validity test. The researchers distributed a questionnaire formatted as a validation sheet to collect evaluations from media specialists. Each expert assigned scores to the questions and provided constructive feedback on the media developed. The media validation document consists of a total of 17 questions, and the findings from the media validity tests conducted by the experts are summarized in Table 4.

Table 4. Results of the media validity test

No	Aspect	Score T	Maximum Score	Persentase	Information
1	Graphic Aspects	28	32	87,5%	Very worthy
2	Media Presentation Aspects	11	12	91,6%	Very worthy
3	Media Content Aspects	11	12	91,6%	Very worthy
4	Linguistic Aspects	10	12	83,3%	Very worthy

The exploading box media achieved an average percentage score of 88.23% following evaluations by media experts across four distinct aspects, as presented in Table 4, indicating its high feasibility. In terms of graphics, which assess the media's appeal, dimensions, quality of base materials, uniqueness, color, appropriateness of design, and accuracy of image layout, the media received a score of 87.5%. The media presentation aspect, which evaluates ease of use, alignment with the characteristics of elementary school students, and the application of the exploading box media, attained an impressive score of 91.6%. Similarly, the media content aspect, focusing on enhancing students' understanding of local wisdom, fostering scientific attitudes, and promoting scientific literacy, also garnered a score of 91.6%. Finally, the linguistic aspect, which encompasses typography, clarity for student comprehension, and information presented in the scientific literacy cards, received a score of 83.3%. Following these evaluations, media specialists provided constructive feedback and suggestions regarding the developed exploading box media, including recommendations for incorporating a sequential flow for material presentation between the sides of the box and numbering the content related to the batik stage.

Subsequently, Mrs. A.D., a lecturer at PGSD UMS with a specialization in science and recognized expertise in the field, conducted a material validity test. The validity of the material was assessed based on content appropriateness, presentation suitability, and linguistic accuracy. The researchers distributed a validation sheet-style questionnaire to subject matter experts for their evaluation. Each expert assigned scores to the questions and provided reviews or comments on the media material developed by the researchers. The material validation sheet comprised a total of 15 inquiries, and the findings from the material validity test conducted by the experts are summarized in Table 5.

Table 5. Results of material validity test

No	Aspect	Score Total	Maximum Score	Persentase	Information
1	Content Feasibility Aspect	19	20	95%	Very worthy
2	Presentation Feasibility Aspect	27	28	96,4%	Very worthy
3	Linguistic Aspect	11	12	91,6%	Very worthy

The evaluation of the three assessed aspects yielded an impressive average percentage score of 95%, as illustrated by the results of the material expert testing outlined in Table 5. The content contained within the exploading box media is considered highly appropriate. Specifically, the content feasibility aspect of the material validity test, which encompasses alignment with learning outcomes and objectives, the development of students' scientific attitudes, and cognitive levels suitable for fourth-grade students, received a score of 95%. This assessment also includes the enhancement of students' scientific literacy skills. Furthermore, the content feasibility aspect, which evaluates the material's alignment with students' learning needs, its integration with local wisdom, the scientific presentation requiring critical thinking, the optimization of students' scientific literacy, and the creation of an engaging and interactive environment, achieved an outstanding score of 96.4%. The linguistic aspects, which focus on effective language use that facilitates comprehension and is appropriate for student development, received a score of 91.6%. Following this, subject matter specialists provided feedback in the form of notes, offering suggestions regarding the content of the exploading box media developed by the researchers. Their recommendations included numbering the batik stage, differentiating science literacy cards by color in accordance with learning objectives, placing usage instructions in the first or outermost box, renaming various forms of matter to changes in the form of matter, and changing properties of the form of matter to properties and various forms of matter. The revised appearance of the exploading box media is sequentially illustrated in Figure 5, Figure 6, Figure 7, and Figure 8.

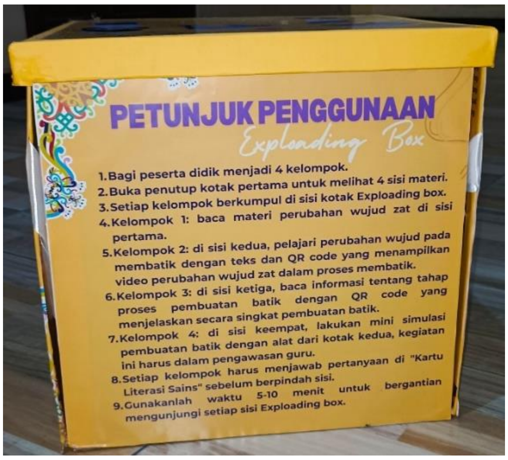
Translation:
5a
Let's learn the process of science through Surakarta's local wisdom of making batik
5b
Translation equal to 3d
5c
Translation equal to 3c
5d
Translation equal to 3b

Figure 5. Appearance of the exploading box media after revision

Transalation:

1. Each form of substance has different properties. For example, solids have a fixed shape and volume, while liquids have a fixed volume but their shape follows the container. If you put water in a glass, the shape of the water will follow the glass, but the volume does not change. Based on this statement, the nature of the liquid substance in question is
2. Fixed shape, changed volume
3. Shape changes, volume remains
4. Shape and volume change
5. Shape and volume fixed
6. Rani and her friends are participating in batik making activities at school. In the first stage, they have to heat the wax (candle) so that it becomes liquid so that it can be easily used to cover parts of the fabric that will not be exposed to dyes. When the wax is heated, what changes in form does it undergo?
7. Candle melts into gas
8. Candle melts into liquid
9. The wax freezes into a solid
10. Candle evaporates into gas
11. Science literacy cards based on ethnoscience

Figure 6. Science literacy card after revision



Transalation:

1. Instructions for using the exploading box
2. Divide learners into 4 groups.
3. Open the lid of the first box to see the 4 sides of the material.
4. Each group gathers at the Exploading box side.
5. Group 1: read the material on changing the state of matter on the first side.
6. Group 2: on the second side, learn about the change of state in batik with text and QR code showing a video of the change of state of substances in the batik process.
7. Group 3: on the third side, read information about the stages of the batik making process with the QR code that briefly explains batik making.
8. Group 4: on the fourth side, do a mini simulation of batik making with the tools from the second box, this activity must be supervised by the teacher.
9. Each group must answer the questions on the “Science Literacy Card” before switching sides.

10. Take 5-10 minutes to take turns visiting each side of the Exploading box.

Figure 7. Location of usage instructions after revision

Transalation:

1. The Stages of Batik Making
2. Making Patterns
3. A batik pattern consists of a main picture and a supporting picture. The filling pattern is drawn while making batik with wax.
4. Dyeing process of the fabric
5. Liquid wax is used with canting to draw the main pattern (nglowong), fill the pattern image (ngisen-iseni), and cover the part of the fabric that will not be colored (nembok).
6. Fabric coloring
7. After the mencanting process, the batik cloth that has been drawn using canting will be colored.
8. Locking color
9. After coloring the fabric, the next step is to lock the color using waterglass.
10. The wax is removed from the cloth by soaking it in hot water until the wax is released.
11. Washing fabric
12. The cloth is washed until clean from the remaining wax, then dried in the shade, not exposed to direct sunlight.

Figure 8. Batik stages material after revision

Discussion

Development of differentiated exploading box media based on ethnoscience

The exploading box learning media is a cube-shaped educational tool with dimensions of 30 cm x 30 cm. It comprises two compartments filled with ethnoscience-based materials centered around batik activities, tailored to accommodate diverse learning styles of students. The objective of this study is to foster students' enthusiasm for learning, particularly in the context of Natural and Social Sciences (IPAS) education, by integrating cultural elements into the curriculum. To accomplish this, the researcher has developed an ethnoscience-based exploading box learning media grounded in a local wisdom approach specific to the city of Surakarta, with a focus on batik. In alignment with this goal, the study by Rahayu & Sudarmin (2015) the ethnoscience approach increases students' enthusiasm and interest in learning because it is accompanied by local wisdom that can trigger students' curiosity. Ethnoscience-based learning is believed to enhance the relevance of the material being studied to students' daily lives, thereby fostering a love for local culture and improving students' understanding of abstract science concepts. Science education is expected to connect students' culture with a scientific approach, thereby strengthening the learning process in schools (Fahrozy et al., 2022). In its development process, this media was implemented in the Natural and Social Sciences (IPAS) subject for fourth-grade elementary school students in accordance with the latest learning outcomes set by the Ministry of Education and Culture (Kemendikbudristek) number 0.32/H/KR/2024 regarding learning outcomes in early childhood education, basic education, and secondary education in the independent curriculum (Badan Standar Kurikulum dan Asesmen Pendidikan, 2024).

The design of the exploading box learning media uses differentiated learning to provide an interactive learning experience tailored to the varied learning styles of students, whether visual, auditory, or kinesthetic. The differentiated learning approach emphasizes the adjustment of instructions and learning materials to match the students' levels of understanding, learning styles, learning speeds, interests, and learning needs (Andajani, 2022). Each side of this exploading box presents information and activities related to the concept of changes in the state of matter, both in general and specifically in the batik-making process, such as the change in the state of wax. Through the simple simulation provided, students can directly engage in batik-making activities, allowing them to concretely understand the scientific process. The ethnoscience of Semanggi batik contains scientific concepts inherent in the community's understanding of science and can be used in science teaching (Suryanti et al., 2021). In this way, the displaying box serves as a learning aid that can integrate theoretical concepts with practical applications, so enhancing the learning process's differentiation. Students who use educational material based on learning styles achieve better learning outcomes than those who do not use strategies based on learning styles. In this way, the displaying box serves as a learning aid that can integrate theoretical concepts with practical applications, thus enhancing the learning process. Students who use learning media based on learning styles achieve better learning outcomes than those who do not use learning strategies based on learning styles (Choir & Anistyasari, 2017). As an example, the IPAS media exploading box has several features based on entrains, including 1) media for learning that uses QR codes as visual aids through videos, The media exploading box uses a contextual approach through the local wisdom of Surakarta, which is membatik, 3) it provides a mini-simulation so that students can practice membatik and quietly observe the steps involved in the membatik activity, and 4) it has a unique design.

The media exploading box is a type of pedagogical media that is based on students' learning styles, such as visual, auditory, and kinesthetic learning styles. In the media exploading box, visual learning is facilitated by textual materials that include images and illustrations. In education, the use of visual aids is crucial because teachers must understand students in a more concrete learning phase. Images, text, graphics, and animation can all be used to illustrate visual media (Hildayah, 2019). The auditory learning process in the media exploading box is accompanied by a QR code that contains a film on the changes in zat during the membatik process. Students with auditory learning methods focus more on explaining things clearly and effectively when the teacher is speaking (Rizki & Ningsih, 2024). In contrast, the kinesthetic learning method in the media exploading box is a miniature membatik simulation. Students employ kinesthetic learning techniques through movement, tactile engagement, and targeted actions to assimilate information and enhance comprehension (Setianingrum, 2017). It is possible to maximize the literacy skills of students by implementing diverse educational media. In line with the results of research by Oktapia et al. (2024) that the application of differentiated learning with a problem-based learning model has an effect on science literacy skills.

This entrains-based media exploading box has the potential to be a tool for enhancing students' literacy skills, particularly in understanding phenomena related to zat changes. The use of ethnoscience-based learning tools affects the improvement of students' science literacy skills (Kriswanti et al., 2020). Using entrains, this media explains scientific concepts more in line with the daily lives of students. As a result, students are not only able to learn scientific theories in an abstract way, but and see how they are used in their daily lives through membatik activities. Lidyawati (2021) explains that educational programs that include entrains aim to improve student's learning outcomes, whereas problem-based learning models are designed to increase students' understanding of concepts. Students' understanding of science concepts, such as changes in the state of matter, is easier to understand when it is connected to the process that students all day. Using this medium can help students understand how the state of matter has changed during the process of becoming more critical and analytical. This is in line with the opinion of to Kriswanti et al (2020) that science learning needs to be contextual and accustom students to make direct observations of science objects, which are then actualized through experimental activities so that students can gain direct experience.

Result of media exploading box validation on ethnoscience

The validation results indicate that the exploading box media is of excellent quality for teaching purposes. As per the findings from the experts, the media validation achieved an average percentage score of 88.23%, while the material validation reached an average percentage score of 95%. These results demonstrate that the learning materials are valid and effective, ensuring alignment with the desired level of proficiency. This is consistent with the theoretical framework articulated by Suartama (2016) media is deemed valid if it meets established quality criteria. The assessment aspects in the media validation testing, which include graphics, presentation, content, and language, yield results that align with very high standards. The results of the material validation, encompassing the elements of content feasibility, presentation feasibility, and language, indicate that the materials are highly suitable for use in IPAS instruction for fourth-grade elementary school students.

The media validation results conducted by media experts encompassed several aspects: graphics, presentation, content, and language. The graphics received a commendable score of 87.5%, categorizing it as very high. However, there remain some concerns regarding the graphics, including the quality of the underlying materials, the media dimensions, which may not be entirely suitable for elementary school students, and issues related to warnings and text within the exploading box media. It is essential for the teacher to focus on enhancing the quality of the media. An effective educational medium should be durable, resilient, and designed for reuse in future student learning processes (Nurrita, 2018). The presentation aspect of the media garnered outstanding results, achieving a percentage score of 91.6%. This reflects that the media is systematically organized and interactive, thereby promoting user engagement in the learning process. Regarding the content, the validation results affirm that the information provided is accurate, relevant, and aligned with the learning objectives. As a result, the media is highly recommended, receiving robust endorsement with a percentage score of 91.6%. As per Tasmalina & Prabowo (2018), the educational media must ensure that materials are presented effectively and aligned with the learning objectives. The language aspect and scored relatively high, achieving a percentage score of 83.3% due to its clarity, alignment with the student's comprehension level, and freedom from grammatical issues. Overall, the validation results for each aspect of the media indicate that the exploading box media is an excellent tool for effective and engaging learning. The media's appeal, uniqueness, and ease of use are highly regarded, as reflected in the validation scores for both the presentation and content aspects (Diani & Hartati, 2018).

The results of the material expert validation test focus on three key aspects: content feasibility, presentation feasibility, and language. The content feasibility aspect received an impressive score of 95%, signifying that the material aligns effectively with educational objectives, addresses student needs, and maintains a high level of accuracy, making it highly relevant for student development. The content encompasses essential concepts necessary to achieve the desired competency level, thereby facilitating efficient progress toward learning objectives. A primary criterion underscores the importance of ensuring that the material closely corresponds with both the learning goals and the capabilities of the students, thereby promoting a comprehensive approach to enhancing student understanding (Tyas et al., 2024). The presentation feasibility aspect achieved an impressive score of 96.4%. The content within the exploading box media is organized in a systematic and logical manner, facilitating ease of understanding for students. The presentation incorporates engaging elements, such as illustrations and relevant examples, alongside exercises and problem scenarios that enhance students' grasp of the material. This aspect encompasses various criteria, including alignment with learning objectives, clearly defined learning stages, engaging and motivating content, ease of comprehension, coherence of material, and the provision of exercises and opportunities for problem-solving (Thalib et al., 2022). This evaluation results in a "highly suitable" rating for the presentation aspect as assessed by material experts. Meanwhile, the linguistic aspect achieved a score of 91.6%, indicating that the language employed is highly appropriate. It is accessible, clear, and unambiguous for fourth-grade elementary students. The use of simple yet precise terms and sentences further enhances students' comprehension of the material. This approach aligns with broader educational goals, ensuring that language serves to facilitate understanding rather than impede it. Apriliana (2017) states that the use of proper and accurate language significantly aids students in understanding the content. Overall, the validation by subject matter experts indicates that all aspects meet high standards, rendering this material highly suitable for use in IPAS learning. Ningtyas & Rahmawati (2023) emphasize the critical importance of content, presentation, and language appropriateness in teaching materials to ensure alignment with the curriculum and to facilitate student comprehension effectively.

Conclusion

The exploading box learning media for IPAS, differentiated through an ethnoscience approach with batik-making activities, was developed using the Research and Development (R&D) method, specifically following the ADDIE development model. The study findings indicate that the ethnoscience-based differentiated exploading box media is highly appropriate for fourth-grade elementary IPAS instruction. Media validation results yielded an average score of 88.23%, while material validation results scored an average of 95%. This media effectively enhances students' science literacy through an ethnoscience approach by integrating batik activities that connect scientific concepts with local wisdom, catering to diverse learning styles and fostering both conceptual understanding and an appreciation for local culture.

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