

Development of STEM-PjBL Science e-Books to Improve Creative Problem Solving Skill of Junior High School Students

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Abstract. 21st century learning requires students to develop problem-solving skills with creative ideas. Identifying objects, formulating problems, exploring creative ideas and choosing the best solution are important skills in solving creative problems. STEM-PjBL learning integrated with the local potential of sand crackers is one alternative to improve their skills. The purpose of writing is to developing a STEM-PjBL model science e-book's on temperature and heat material to improve student's creative problem solving skills of junior high school students. The development model used is 4-D model, with stages including define, design, develop, and disseminate. The research subjects were students of class VIII MTsN 4 Kediri. Data collection was done through tests and non-tests (questionnaires, observations, interviews). The instruments used were product feasibility, validation sheet from material experts and media experts, instrument validation sheet, and practicality questionnaire. The results of the material validation and media validation are very good category with scores of 207 and 329 respectively. The percentage score of practicality questionnaire assessment is 93.9% and the score of the readability questionnaire assessment is 92.7%. The N-gain value of 0.46. It can be concluded that the STEM-PjBL science ebook developed effectively increases students' creative problem solving skill.

Keywords: science e-book, STEM-PjBL, creative problem solving

Introduction

Natural science (IPA) or nature of science (NOS) is a collection of knowledge that teaches various things, both skills, attitudes and roles in life. Science studies events that occur in nature (Kasinus, 2017; Khaerani et al., 2020). Lederman et al. (2013) revealed that NOS refers to the epistemology of scientific activities carried out. (Mercado et al., 2015) added that NOS refers to principles and ideas that will provide certain knowledge as a step in developing scientific knowledge. Developing high-level thinking skills such as conducting scientific activities, attitudes, critical thinking and reasoning to solve problems and make decisions on various challenges in life is the goal of science learning (Saido et al., 2015).

Temperature and heat are material topics that students always interact with even from the beginning of life (Inaltekin & Akcay, 2021). This temperature and heat material contains changes in temperature, heat, and heat transfer which are rather difficult to learn

because of its abstract nature, which can lead to different thoughts (Komikesari et al., 2020). Baser (2006) revealed that this material tends to be abstract and theoretical so that students are found to have a misunderstanding of the concept. The material of heat and its transfer is closely related to nature and phenomena related to concepts in the process of measurement, experimentation, reasoning, and problems (Chiappetta & Koballa, 2010).

Mastery of temperature and heat in the national exam (UN) in one of the junior high schools in Kediri Regency in the 2015/2016 school year amounted to 52.80% and in the 2016/2017 school year amounted to 51.29%. These learning results show that there is a decrease in the percentage of mastery of temperature and heat material and these results are still below the KKM (minimum competency) standards that must be achieved (Innatesari et al., 2020). Flavian (2017) states that students still have difficulty in explaining the relationship between temperature and heat and the concept of heat energy that passes from one object to another with a temperature difference. In addition, students still have difficulty with the concepts of thermal conductivity, coefficient of expansion, specific heat and boiling point and melting point of liquids on thermometers (Sukarmin et al., 2017). Hayati et al (2022) in their research revealed that in the pre-research conducted by the teacher showed that the average score of seventh grade students in the material was still predominantly below the KKM 75. Learners have difficulty in distinguishing how to transfer heat, calculating heat and understanding that is different for each student because of abstract concepts.

Along with developments in the 21st century, schools are expected to prepare learners to face and solve more complex problems (Elma et al., 2022), and have the skills of creative thinking, critical thinking, communication, and collaboration (Inayah et al., 2023; Irenka & Eccles, 2014). Improving learners' skills is important to prepare learners to face future global challenges. Learners are not only emphasized on knowledge, but on problem solving. Based on this, it is necessary to emphasize the role of the teacher as a facilitator in guiding innovative student learning (Oktaviani & Nugroho, 2015).

Creative problem solving is an ability to think creatively towards solving problems imaginatively and effectively (Fisscher, 2008; Nuraziza & Suwarma, 2018). Mitchell & Kowalik (1999) revealed that creative problem solving produces effective and imaginative problem-solving actions and consists of 1) objective finding, 2) fact finding, 3) problem finding, 4) idea finding, 5) solution finding, and 6) acceptance finding. Creative problem solving will lead learners to creative solutions to problems found in life. Based on the 21st century learning scheme, learners must have the ability to obtain information from various sources, formulate problems, think analytically and cooperate and collaborate in solving problems (Musnidar, 2018). Therefore, it is important that students develop creative problem solving in science learning.

The results of research conducted by Hilmi et al (2020) show that the ability to find creative ideas and find solutions to problems is still low, namely 27.78% and 24.07%, and finding and formulating problems obtained a percentage of 42.59%. Other facts found that students are still weak and insensitive in finding problems and problem solution ideas (Isrok'atun & Tiurlina, 2014; Mutaqin, 2016). Based on the results of interviews with 7th grade science subject teachers at MTsN 4 Kediri, some information was obtained including; students tend to be less than optimal in analyzing a problem or phenomenon, less confident in their ideas and the solutions they think. The discovery of facts and problems is still not optimal, the learning support facilities in the classroom are also still minimal, thus inhibiting the exploration of knowledge when learning. Amran et al (2019) in their research revealed that weak CPS can also be caused by a lack of encouragement and motivation, which will hinder the emergence of creative thoughts when learning activities take place. In addition, students tend to depend on the teacher in solving problems. Students still tend to have difficulty with temperature and heat material because it contains calculations and has the characteristics of material that can be initiated by observation.

Science subjects have a variety of materials related to daily life and the environment. Science learning can be done contextually, one of which is realized by integrating local potential, one of which can be related to local potential (Anisa, 2017). This is in line with the existence of the Law of the Republic of Indonesia Number 20 of 2003 concerning the national education system article of community-based education that the community has the right to organize community-based education both formal and non-formal education tailored to the peculiarities of religion, social environment, and culture for the benefit of the community. Each region has different local potential according to the location of the area. Kediri district is one of the districts/cities in East Java province. Kediri Regency has a variety of local potentials, one of which is upil crackers or also known as kali crackers. The utilization of local potential in learning will make students understand the material with activities that provide direct experience with learning resources, become more creative and free to explore and analyze information related to learning materials in depth (Anisa, 2017).

There are several things that become obstacles in implementing science learning that is integrated with local potential in certain materials. Students experience problems in understanding the material, one of which is caused by the printed teaching materials used that do not prioritize environmental elements and local culture of the local community (Masihi & Augustyn, 2021), teachers who are less trained in developing their own teaching materials (Suryanda et al., 2020), lack of understanding of the meaning of science in local culture is one of the causes of teachers' difficulties in linking learning materials with scientific values of local culture (Damayanti et al., 2017).

The solution to the low creative problem solving is to develop an electronic science teaching material that will guide students in carrying out learning activities and train students' creative problem solving that can be integrated with local potential, so that they are not fixated on what is given by the teacher. e-Books have characteristics, among others, are software products with structures such as books in general, can work with the internet or not, are equipped with animated images, videos to deepen understanding, have e-book readers, and integrate technology in them (Nguyen, 2015; Suwarno & Rahmatullah, 2020). Problems can be visualized well in e-books with videos and images loaded. The use of e-books in learning is as a guide for students in carrying out learning activities and maximizing students' independent learning activities (Muga et al., 2017). The function of e-books in learning is as a learning guide by teachers and students and is one of the important factors in the success of learning (Susilo & Pahlevi, 2021). The use of e-books packaged in the form of flipbooks has advantages, namely making learning more interactive and efficient according to the character of the material (Andini et al., 2018), can integrate sound, video, graphics, animation or images that will enrich information than conventional books and can concretize abstract concepts that are difficult for teachers to explain (Aprilia et al., 2017).

Science, technology, engineering, and mathematics (STEM)- project based learning (PjBL) is a learning model that uses PjBL model and STEM approach. PjBL directs students to investigate and understand complex problems and reveal the best solution to these problems, is able to facilitate collaboration between other members in a group to complete projects that are done together, is designed to guide students through collaborative projects that integrate various learning resources (materials), provide opportunities for students to explore learning in various meaningful ways and allow collaboration in conducting experiments (Dewi, 2022; Pujiastuti, 2021; Saenab et al., 2019). The integration of STEM in learning can foster various abilities of students including problem solving, being open to technology, creativity and being able to communicate and have collaborative abilities, the science element will teach students to solve problems (active, creative and innovative), the technology aspect will help students design creative technological ideas as a solution (Chania et al., 2020; Khoerunnisa et al., 2022; Yuanita & Kurnia, 2019).

Based on the problems described, the development of science e-books STEM-PjBL model of temperature and heat material makes students more interested in learning science and better understand the problems presented with video, audio, images so that students can observe the problem more deeply. In addition, project-based learning integrated with STEM can increase students' interest in learning, learning becomes more meaningful so that it can improve students' mastery of concepts (Tseng et al., 2013). After mastering the concepts, students will be trained to analyze problems, and associate with STEM elements in learning temperature and heat so as to create a work as the best solution, so that students become trained in creative problem solving skill using e-book STEM-PjBL. The purpose of writing is to develop a STEM-PjBL model science e-book on temperature and heat material to improve the creative problem solving skills of junior high school students. The developed science e-book integrates the local potential of kediri upil crackers. with the development of this STEM-PjBL science e-book integrated with the local potential of upil crackers, students are able to improve creative problem solving skills on temperature and heat material.

Methods

The research conducted is a research & development research and development that aims to produce a product that is feasible (Sugiyono, 2015). The model used in this research is the 4-D model from Thiagarajan (1974) with 4 steps, namely from 1) define, 2) design, 3) develop, 4) disseminate (Thiagarajan et al., 1974). The advantages of the 4-D development model are that it does not require a long time and the development stages given are relatively not too complex (Maydiantoro, 2021). The research subjects were students of class VIII MTsN 4 Kediri. Validation was carried out by 1 material expert and 1 media expert, the practicality test was carried out by 1 field practitioner (science teacher), and the readability test was carried out by 15 students. The resulting product is a STEM-PjBL science e-book to measure creative problem solving on temperature and heat material. Details of the research stages and the results obtained are presented in Table 1.

Table 1. Stages and results of 4-D research model.

No	Stages	Result
1.	Define	The results of the initial analysis, learner analysis, task analysis, concept analysis, and analysis of learning objectives as a guide in developing science e-book products.
2.	Design	Consists of the initial product design process, creative problem solving ability instruments, material and media validation assessment instruments by material and media expert validators, practicality test questionnaires by students, and readability test questionnaires by educators.
3.	Develop	STEM-PjBL science e-book products, results of validation assessments by material expert validators and media expert validators, results of readability test questionnaires and practicality test questionnaires, and revised results.
4.	Disseminate	Product distribution in the form of STEM-PjBL science e-books and article publications.

The data collection techniques used in this study consisted of test and non-test techniques (questionnaires, observations, interviews). The data collection instruments used consisted of validation sheets by material expert validators and media expert validators, practicality questionnaires by educators and readability questionnaires by students. The data obtained from this study are quantitative data and qualitative data. The data analysis technique used was descriptive qualitative analysis and quantitative analysis. The effectiveness of the product is obtained from the results of the pretest and posttest creative problem solving.

At the define stage, analysis of problems at school, analysis of learner characteristics begins with analyzing the problems found, learner characteristics, task analysis, concept analysis, and analysis of learning objectives through literature studies, observations and interviews. The results obtained at the define stage will be used as guidelines in making product guidelines, namely the STEM-PjBL science e-book. The design stage consists of steps for preparing research instruments, selecting teaching materials, selecting teaching material formats, and initial designs. In addition, expert validation sheet instruments, readability test questionnaires and practicality test questionnaires were made. The develop stage consists of the validation process of the initial product developed. Validation was carried out, namely material expert validation and media expert validation conducted by expert validators from 2 lecturers from FMIPA UNY. In addition, at this stage, the readability test and practicality test of the science e-book that has been developed by 1 science teacher and 15 students from MTsN 4 Kediri. The last stage is disseminate which is carried out by distributing products to the research school, namely MTsN 4 Kediri and publishing scientific articles.

The assessment of the feasibility of science e-books by validators uses a 5-scale Likert scale, namely 1,2,3,4, and 5 (Likert, 1932). Furthermore, the results of the 5-scale validator where the initial data in the form of scores are converted into qualitative data on a scale of 5. On a Likert scale, the highest score is 5 and the lowest is 1. The ideal assessment criteria used refer to Mardapi (2008) which is presented in Table 2.

Table 2. Ideal assessment criteria

No	Interval Score	Value	Category
1.	$X \geq X_i + 1.8 \text{ SBi}$	A	Very good
2.	$X_i + 0.6 \text{ SBi} < X \leq X_i + 1.8 \text{ SBi}$	B	Good
3.	$X_i - 0.6 \text{ SBi} < X \leq X_i + 0.6 \text{ SBi}$	C	Fairly Good
4.	$X_i - 1.8 \text{ SBi} < X \leq X_i - 0.6 \text{ Sbi}$	D	Not Good
5.	$X \leq X_i - 1.8 \text{ SBi}$	E	Very Poor

Practicality and readability questionnaires of e-books are given to teachers and readability questionnaires are given to students using a Likert scale with five intervals with a score of each option 5, 4, 3, 2, 1 (Likert, 1932). The total score results will be summed up using the Average score (X) formula. Furthermore, the percentage of the average score for practicality (P) and readability (PK) was obtained. The formula for calculating the percentage of practicality and readability according to Sarip et al. (2022).

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

$$PK = \frac{\sum X}{N} \times 100\% \quad (2)$$

Description:

P = percentage of practicality

PK = percentage of readability

$\sum X$ = number of scores obtained

N = total maximum score of practicality

The criteria used to analyze the results of the practicality test questionnaire by educators according to Riduwan (2016) are presented in Table 3, while Table 4 contains the criteria for the results of the readability test questionnaire by students according to Sarip et al. (2022).

Table 3. Practicality test assessment criteria

No	Practicality test (%)	Category
1.	0 - 20	Very impractical
2.	21 - 40	Not practical
3.	41 - 60	Practical enough
4.	61 - 80	Practical
5.	81 - 100	Very Practical

Table 4. Readability test assessment criteria

No	Readability test (%)	Category
1.	80.1 - 100	Very good
2.	60.1 - 80	Good
3.	40.1 - 60	Medium
4.	20.1 - 40	Not good
5.	0 - 20	Not very good

The effectiveness of science e-books in improving creative problem solving skills is calculated using the N-Gain score based on the pretest and posttest creative problem solving scores using the calculation of the N-Gain score with the following equation.

$$g \geq \frac{S_f - S_i}{100 - S_i} \times 100\% \quad (3)$$

N-Gain score criteria used to determine the effectiveness of science e-books according to Hake (1999) are presented in Table 5.

Table 5. N-Gain score criteria

Interval	Category
$g > 0.7$	High
$0.7 > g > 0.3$	Medium
$g < 0.3$	Low

Results and Discussion

The product of this development research is a product in the form of a STEM-PjBL science e-book on temperature and heat to improve creative problem solving. This science e-book product has been developed by following the 4D development steps namely define, design, develop and disseminate (Thiagarajan et al., 1974). The results of the material development were implemented to VII grade students of MTs Negeri 4 Kediri.

This define stage consists of initial analysis steps, learner analysis, task analysis, concept analysis, and analysis of learning objectives. The curriculum currently used at MTs Negeri 4 Kediri is the merdeka curriculum for grades 7, 8, and the 2013 curriculum for grade 9. The implementation of the merdeka curriculum in schools is relatively good and is carried out at the beginning of learning, but during the learning process students still tend to need more guidance and direction from the teacher. The results of interviews conducted with one of the science teachers at MTs Negeri 4 Kediri found that most 7th grade students were still unable to explore their ideas as a solution. In addition, in expressing the facts they encounter are still lacking. Sometimes students are able to choose creative ideas, but the reason for the selection behind the idea is still not strong so that improvement and habituation are still needed. The learning outcomes of students are

relatively sufficient with the findings of daily test scores and midterm exams showing that some students still get scores below the KKM. The learning process that takes place at school is also still dominated by conventional methods, namely giving assignments and lectures. Analysis of tasks, learning objectives and the flow of learning objectives is adjusted to the integration of making and frying crackers as local potential in accordance with the concepts of temperature and heat material.

This developed science teaching material is based on the formulation of learning activities contained in the previous stage to determine the need for teaching materials in the learning process at the define stage. The results of the analysis conducted showed that the need for the development of science teaching materials in the form of STEM-PjBL science books. The design stage is carried out the preparation of research instruments, selection of teaching materials, selection of teaching material formats, and initial product design. The instruments used include tests to determine the increase in creative problem solving in the form of pretest and posttest questions, material expert and media expert validation sheets, teacher practicality questionnaire sheets and student readability sheets. The format of teaching materials chosen is in the form of STEM-PjBL science e-books using the canva application. Meanwhile, the application used to convert into electronic form is using heyzone flipbook. Selection of teaching materials in the form of e-books because they are flexible and easy to use. This is in line with Asrowi et al (2019) that ebooks are more durable, not easily torn, environmentally friendly, more practical and can be used anytime and anywhere. Interactive learning such as using ebooks is able to provide a more interactive and dynamic learning experience with content displayed in a more flexible way (Ebner et al., 2016). The selection of the heyzone flipbook application because it can convert PDF files into books and can include links, figures, videos, audio, and the web in it. Technology can be integrated in books in the form of ebooks equipped with multimedia objects (audio, video, animation) and interactions (such as touch, drag) (Ormancı & Çepni, 2020). The initial design of the ebook includes the front cover, preface, table of contents, list of figures, list of tables, user instructions, STEM-PjBL aspects, introduction to making and frying upil crackers, initial assessment, concept map, materials, posttest, glossary, bibliography and cover. The eBook developed on temperature and heat material is adapted to the STEM approach and the PjBL model with the following syntax: 1) Start with the essential question, 2) Design a plan for the project, 3) Create a schedule, 4) Monitor students and project progress, 5) Assess the outcome, and 6) Evaluate the experience.

The next stage is develop. This stage is the realization of making STEM-PjBL science ebooks using canva which will be adjusted to validation (media experts and material experts) practicality tests by science teachers and readability tests by students. The results of product revisions are listed in Table 6. The final results of the STEM-PjBL science ebook are presented in Table 7.

Tabel 6. Results of product revision

Validator Comments	Before Revision	After Revision
Learners are given the freedom to do the project according to creative ideas that emerge as solutions, should not be directly determined.		

Attention to legible writing in terms of font and size in the e-book.



Table 7. Final result of STEM-PjBL science e-book



Figure 1. Cover of the science e-book



Figure 2. Preface to the science e-book

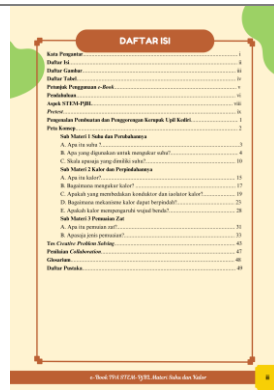


Figure 3. Table of Contents



Figure 4. List of Images



Figure 5. List of tables

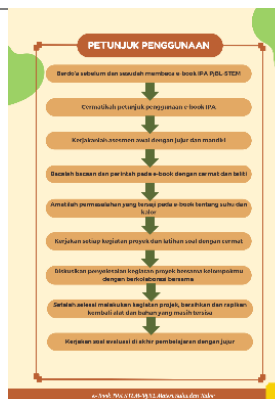


Figure 6. Instructions for using e-books



Figure 7. Introduction



Figure 8. STEM-PjBL aspects

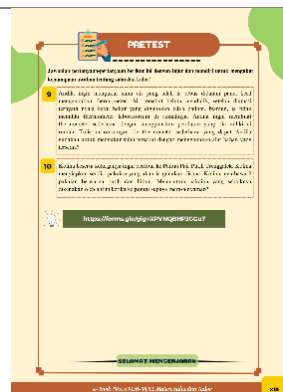


Figure 9. The first assessments



Figure 10. Introduction to making & frying crackers



Figure 11. Material concept map



Figure 12. Sub material 1 on science e-books



Figure 13. Sub material 2 on science e-books



Figure 14. Sub material 3 on science e-books



Figure 15. Creative Problem Solving Test



Figure 16. Glossary



Figure 17. Bibliography on science e-books



Figure 18. Back cover

After being developed, the ebook was validated by validators to assess material validation and media validation. The assessment was carried out by two lecturers from FMIPA UNY. In addition, a practicality test was conducted by 1 science teacher and a readability test by 15 students. The effectiveness of the product can be known by

conducting pretest and posttest creative problem solving on temperature and heat material. The purpose of this stage is to determine the feasibility, practicality, readability and effectiveness of the STEM-PjBL science ebook products developed.

Validation by material experts has 7 aspects. The content feasibility aspect consists of the suitability of the material with KI and KD, the accuracy of the material, the currency of the material, the correctness of the concept, and encouraging curiosity. The presentation feasibility aspect consists of presentation techniques, presentation support, presentation of learning, and coherence and conciseness of thought flow. The linguistic aspect consists of straightforward, communicative, dialogical and interactive, and suitability with learner development. The aspect of compatibility with creative problem solving consists of loading objective finding indicators, loading fact finding indicators, loading problem finding indicators, loading idea finding indicators, and loading solution finding indicators. Aspects of STEM-PjBL characteristics consist of loading conformity with PjBL syntax, STEM aspects, and local potential. The results of the e-module material expert validation test are shown in Table 8 while the results of the e-module validation test by media experts are shown in Table 9.

Table 8. Results of e-book material expert validation test

No	Aspect	Average Score	Total Value	$\bar{X}_i + 1.8 S_{bi}$	Value	Category
a)	Feasibility of content	4.64	65	58.8	A	Very Good
b)	Feasibility of presentation	4.5	81	75.6	A	Very Good
c)	Feasibility of language	4.167	75	75.6	B	Good
d)	Appropriateness of creative problem solving	4.5	45	42	A	Very Good
e)	Characteristics of STEM-PjBL	4.5	27	25.2	A	Very Good

Based on Table 8, it shows that the results of the validation of the material expert validation instrument obtained $X = 293$, meaning $X > 277.2$. This value falls into the very feasible category. So that the STEM-PjBL science e-book developed is very feasible when viewed from the feasibility of material experts. In the aspect of feasibility of content getting an X value of 65 ($X > 58.8$), feasibility of presentation getting an X value of 81 ($X > 75.6$), feasibility of language getting an X value of 75 ($X > 75.6$), suitability of creative problem solving getting an X value of 45 ($X > 42$), and stem-pjbl characteristics getting an X value of 27 ($X > 25.2$). Based on the validation results, it can be concluded that this STEM-PjBL science e-book is feasible from the material aspect for limited testing. Validator suggestions and comments are as follows; 1) Learners are given the freedom to carry out projects according to creative ideas that emerge as solutions, should not be directly determined, 2) Sentence simplification is carried out, and 3) The description of the material is sorted out which is important to write and which is not, so that it is more effective. Based on the results of the material expert validation assessment, it shows that the developed STEM-PjBL science ebook is in accordance with the characteristics of STEM-PjBL. According to Krajcik & Shin (2014) PjBL has 6 characteristics including encouraging questions, focusing on learning objectives, providing space for participation, collaboration between students, utilizing technology, and creating real artifacts. The material in the e-book must use simple, communicative language, and be adapted to the age level of students so that it is easy to understand, learn and operate independently (Khasanah et al., 2023).

Media expert validation uses 2 aspects. In the aspect of graphic suitability, there are indicators of e-book size suitability, cover design suitability, cover size suitability, cover illustration suitability, layout suitability, and topography suitability. Meanwhile, the language suitability aspect has an indicator of sentence suitability. The results of the media expert validation test are presented in Table 9.

Table 9. Media expert validation test results

No	Aspect	Average Score	Total Value	$\bar{X}_i + 1.8 S_{bi}$	Value	Category
1	Graphics Suitability	4.54	163	151.2	A	Very Good
2	Language Suitability	4.4	44	42	A	Very Good
Average		4.5	207	193.2	A	Very Good

Based on Table 9, it shows that the results of the validation of the media expert validation instrument obtained $X = 207$, meaning $X > 193.2$. This value falls into the very feasible category. Based on the validation results, it can be concluded that this STEM-PjBL science e-book is feasible from the media aspect for limited testing. The validator's suggestions and comments are as follows; 1) Pay attention to legible writing in terms of font and size in e-books, and 2) Simplification of sentences. Apsari & Kustijono (2017) revealed that ebooks can make students learn interactively through the addition of images, videos, and animations. A teaching material should have a font size that is not too small, equipped with images that clarify information with a proportional size, and contain other learning resources (Mashinta et al., 2015).

After the validation test by experts, the science ebook will be tested for practicality and readability. In the practicality test, the STEM-PjBL science e-book product was carried out by teachers or science teachers at school. The assessment aims to determine the practicality of using the product. The practicality questionnaire of this STEM-PjBL science e-book product contains several aspects that are assessed, namely grammar, language, product characteristics, and content feasibility. Table 10 presents the results of the STEM-PjBL science e-book practicality questionnaire.

Table 10. Questionnaire results for the practicality of STEM-PjBL science e-books

No	Aspect	Average Score	Score of Practicality (%)	Category
1	Graphics	27	90	Very practical
2	Language	25	100	Very practical
3	Product Characteristics	14	93	Very practical
4	Content Feasibility	37	92.5	Very practical
Average		25.75	93.9	Very practical

Based on Table 10, it is known that the graphical indicator gets a percentage of 90%, the language indicator gets a percentage of 100%, the product characteristics indicator gets a percentage of 93%, and the content feasibility indicator gets 92.5%. The overall average result of the practicality of science e-books is 93.9% with a very practical category. Based on these results, it can be concluded that this STEM-PjBL science e-book is practically used in learning.

The readability test was conducted with the aim of knowing the ease of reading and using the product. The students who took the readability questionnaire were 15 students. The assessment by students includes several indicators, namely 1) the language used in the science e-book is brief, clear and understandable, 2) the clarity of the writing in the science e-book, 3) the clarity of the images in the science e-book, 3) the cover of the science e-book is attractive, easy to understand, and explains the contents of the science e-book, 4) attractive appearance of science e-books, 5) color composition in science e-books, 6) material language in science e-books that are understood, 7) ease of use of teaching materials, 8) illustrations of problems relevant to everyday life, and 9) activities that help understand the material. Table 11 presents the results of the STEM-PjBL science e-book readability questionnaire.

Table 11. Results of the readability questionnaire of the STEM-PjBL science ebook

No	Aspect	Average Score	Score of Readability Questionnaire (%)	Category
1	Language	65	92.9	Very good
2	Clarity of Presentation	61	87.1	Very good
3	Graphics	66.2	94.6	Very good
4	Ease of use	67.25	96.1	Very good
	Average	64.9	92.7	Very good

Based on Table 11, it is known that the overall average readability of science e-books is 92.7% with a very good category. Based on these results, it can be concluded that this STEM-PjBL science e-book is easy to read in learning activities. The language aspect is 92.9%, the presentation clarity aspect is 87.1%, the graphical aspect is 94.6%, and the convenience aspect is 96.15. According to Muga et al. (2017) ebooks when used in learning can make it easier to learn a material. The aspect of presenting material on teaching materials is interesting and equipped with problems that can stimulate students to solve problems (Amaliah et al., 2022).

The effectiveness of the product in improving students' creative problem solving skills is done through pretest and posttest after learning. The creative problem solving indicators used in this assessment are object finding, fact finding, problem finding, idea finding, and solution finding. The value obtained is then tested using the N-Gain test score. The N-Gain test is conducted to determine whether or not there is a difference in the test scores of students through pretest and posttest. The results of the N-Gain creative problem solving test are presented in Table 12.

Table 12. Result of N-Gain creative problem solving test

Test	Average	N-Gain	Category
Pretest	74.6	0.46	Medium
Posttest	86.8		

Based on the results in Table 12, it is known that the average Pretest score is 74.6 and the average Posttest score is 86.8. The N-gain value of 0.46 with an N-gain value <0.3 and >0.7 is in the medium category. It can be concluded that the STEM-PjBL science ebook developed effectively increases students' creative problem solving with a difference in value in the moderate category. eBooks that are packaged to develop divergent and convergent thinking to overcome problems or challenges in everyday life are able to improve students' creative problem solving (Isaken, 2023). eBooks that are equipped with activities to explore ideas and alternative ways to overcome deficiencies or obstacles in solving a problem (Amran et al., 2019). eBooks in which provide opportunities for students without hindering them to come up with ideas that are considered creative that are original, systematic and able to be implemented will help improve students' creative problem solving skills (Corazza, 2016). Fiteriani et al. (2020) suggested that creative problem solving skills are more effectively improved by using the PjBL learning model and the STEM approach.

Conclusion

The resulting STEM-PjBL science e-book is in the form of a collection of temperature and heat material in which it is associated with Kediri's local potential, namely upil crackers or kali crackers with a 3-dimensional electronic book presentation using the Hyzine flipbook website and operating using a laptop or smartphone connected to an internet network or wifi. The results of the material validation were 207 (very good category), the media

validation was 329 (is very good category). The percentage score obtained based on the practicality questionnaire assessment by educators is 93.9%. While the score of the readability questionnaire assessment by students obtained a score of 92.7% in the very good category. the average pretest score was 74.6 and the average Posttest score was 74.6. The N-gain value of 0.46 with the N-gain value <0.3 and >0.7 is in the medium category. It can be concluded that the STEM-PjBL science ebook developed effectively increases students' creative problem solving with a difference in value in the moderate category.

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