



Interactive Modules Containing Problem Based Learning with Socioscientific Issues on The Water Cycle Material

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Abstract: The learning innovation developed is combining learning modules with the use of mobile phones so that learning is interactive and meaningful. The preparation of the module uses the PBL stages with the content of socioscientific issues according to what happens in everyday life so that it is expected to train one of the 21st century skills is critical thinking skills and support digitization of education. This study aims to develop an interactive module containing problem based learning with socioscientific issues on the water cycle material and to determine the content and construct validity of the developed learning modules. The method used in development research was adapted from the RnD method with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The data collection technique was in the form of a validation questionnaire for material experts, linguists, and media experts. From the results of data validation and analysis, a percentage of 95.55% was obtained for content validation and a percentage of 97,52% for construct validation, both of which were classified as very valid. From these results it can be concluded that the interactive module containing Problem Based Learning with socioscientific issues in the water cycle material is feasible to use in terms of validity aspects.

Keywords: Problem Based Learning; Interactive Module; Sosio Scientific Issues; Water Cycle

Introduction

Science in the 2013 curriculum aims to enable students to acquire scientific skills, thinking skills, and apply knowledge to problem solving in daily life activities (Widiyatmoko et al., 2020). Science learning must become part of community life, taking place in various policies that involve students and community members in activities that are beneficial to their own lives (Genisa et al., 2020). Each subject in science has its own characteristics, so teachers need to study each of these characteristics so they can teach material effectively and efficiently (Mutanaffisah et al., 2021). In science learning, students not only learn about concepts but must understand a process of phenomena occurring by observing, demonstrating, experimenting, and exploring and constructing material.

Through science learning, students will better understand the surrounding environment so that they are expected to be able to maintain a balanced environment, and take the right attitude towards the natural phenomena they experience. The learning model that can be applied to science learning is the Problem Based Learning (PBL) model. Many researchers have recommended that Problem-Based Learning be applied to various subjects, one of which is Natural Sciences (Susanto et al., 2022). According to Prahani et al. (2022) PBL is a learning model that is relevant to the Indonesian curriculum because the learning system is student-centered. Problem-based learning is a learning model that can encourage students to learn and work together in groups with the aim of finding real-world solutions (Suharini, 2021). This learning model allows students to remember and review material that has been studied,

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show what is known correctly, and find out how to solve problems (Sajidan et al., 2022).

In the application of the PBL model, according to Mardi et al. (2021) students are guided by the teacher in holding joint discussions to solve problems and develop solutions that can be implemented by searching for various relevant information and filtering useful information. Research by Aufa et al. (2021) and (Amin et al., 2020) explained that using the PBL model to conduct learning in the classroom can not only improve students' thinking skills but to instill an attitude of caring for the environment.

Presentation of the problem in the first step of the PBL model, namely the orientation of the problem can be related to issues of social science (socioscientific) that are developing in the surrounding environment. Socio Scientific issue-based learning raises problems in social life which are conceptually closely related to science as solutions to answers, so that it is expected to be able to improve students' critical thinking skills (Pandela et al., 2019). Problems that contain socioscientific issues according to Mahanani et al. (2019) in general will generate controversial debates so as to train students to develop critical thinking skills. Socioscientific issues can be one of the alternative problem contents as a means needed in 21st century learning (Indriani & Jayanti, 2022). Arini et al. (2020) concluded that the implementation of learning with material filled with socioscientific issues can encourage students to discuss finding solutions to social problems to increase understanding and develop scientific explanations. In Indonesia, material containing socioscientific issues has begun to be integrated into classroom learning and the development of teaching materials to support its application, although it is still limited, so teachers must be able to plan student-centered learning based on socioscientific issues (Genisa et al., 2020).

One of the topics in Elementary School Science subject matter that has a lot to do with the problems of everyday life and has a content of social issues in society with science as a solution, namely the material of the water cycle for life. Issues related to the material of the water cycle are the controversy over human activities that damage the environment so that they have an impact on the sustainability of the water cycle such as land expansion, forest fires, environmental regulations. These issues contain open-ended problems, so students are expected to be able to think critically to find solutions.

When students understand the water cycle material well, students will be able to relate their knowledge to issues based on socioscientific issues that are presented with the aim of making appropriate conclusions. PBL can be used as a solution to find a strategy for handling

the impacts caused by human activities on environmental damage such as floods (Suharini et al., 2019). Widiyatmoko et al (2021) suggests that internet-based learning multimedia (in the form of text, graphics, audio, video, animation, and simulation) for visualization of concepts and interactive evaluations made by teachers is still very limited even though the use of educative and interactive media will make learning more better and more interesting for students. Forms of digital media innovation that teachers can develop to apply 21st century learning skills to science learning in elementary schools can be in the form games, digital comics, e-books, flipbooks, augmented reality (AR), virtual reality (VR), and digital applications. (Jannah and Atmojo, 2022).

Based on pre-research data in the form of interviews and documentation with 5 grade V teachers at Gugus Dewi Kunthi Elementary School, Semarang City, learning activities used learning resources in the form of textbooks from the ministry of education and culture which were loaned to students and kept in the classroom. Students are also encouraged to buy Student Worksheets (LKS) at private institutions. Teachers sometimes make their own media in the form of printed images as worksheets for use in learning. In addition, if necessary, the teacher uses props in the laboratory. The teacher explains that students are more enthusiastic and highly motivated if the teacher uses interesting media during learning. The difficulties experienced by students in science learning are in the aspect of literacy that the ability of students to reason about a problem or reading is weak, students are lazy to read so that it has an impact on the low value of learning outcomes.

The learning that takes place is still conventional with lecture methods, group discussions, and sometimes interspersed with games question and answer by reason of the age factor, where teachers are not familiar with various kinds of innovative learning models and technology-based interactive media to be applied in class. The main target carried out by the teacher is the achievement of Basic Competence in each subject. Teachers also complained about the use of cellphones by students to play online games so that it had an impact on learning motivation. If students are given homework assignments, students can easily find answers through the internet without wanting to read the readings in books.

Based on the teacher's data from 56 grade V students, 32 students have their own cellphones and 24 students use their parents' cellphones. This condition has not been utilized properly by students for learning activities and is still limited to internet activities to find information on answers from homework assignments. The use of mobile phones can have a positive impact on students if used for learning activities, such as the

product developed by (Pendit et al., 2022) in the form of the Disroid E-module on sound waves material for Class IV students which runs on Android-based cellphones and has an internet network.

The government through the education office of the City of Semarang encourages the digitization of education in Indonesia by establishing a collaboration in the form of a digital education service called the Pijar platform with PT. Telkom in 370 elementary schools (SD) in Semarang City. All data on the results of teaching and learning activities will be stored digitally so that it will be easier for teachers to review learning outcomes and can be monitored directly by parents and school developments can also be monitored by the Education Office. Therefore, it is necessary to have science and technology-based teaching materials that refer to 21st century skills.

In this research, a new learning media was developed in the form of interactive modules that are displayed digitally through the heyzine platform. The interactive module is designed by applying the steps of the PBL model and raising socioscientific issues so that learning is contextual. This research was conducted to determine the content and construct validity of the developed learning modules.

Method

Research and Development (R&D) research was used in this study with the ADDIE development model. There are 5 (five) stages in the ADDIE Model, namely: analysis, design, development, implementation and evaluation. However, this research is limited only to the development stage (Fitria et al., 2020). The ADDIE development model describes an effective and efficient systematic approach to instructional/teaching development (Ramly et al., 2022).

Analyze

At this stage, preliminary research was carried out to obtain data related to problems in learning science in elementary schools, to find out the learning resources available in schools, and to find out the opinions of educators about module development. Then a needs analysis was carried out in several elementary schools that are members of the Dewi Kunthi Cluster in Semarang City. This stage also determines the competency standards to be achieved and determines the modules to be used.

Design

The design phase begins with designing the learning module framework. The module design stage includes determining module components, water cycle material, PBL stages, types of exercise questions given,

competency tests, learning videos, wordwall-based games, 3D animation and module layouts. Furthermore, an initial product design was produced with a product assessment instrument to serve as a guide in designing interactive modules.

Development

The interactive module design development stage uses several applications, namely: 1) overall module design using canva; 2) making learning videos using Corel Video Studio and uploading them to YouTube; 3) games to review material and ask and answer questions using word walls; and 4) three-dimensional animation of the water cycle using Assemblr Studio.

Implementation

At this stage, the interactive module will be validated by three validators consisting of three lecturers from material, language and media experts. Validity must meet content validity which includes relevance and construct validity which includes consistency. Data validation results will be analyzed in a quantitative descriptive manner in order to provide an overview of the validity of the interactive module developed based on the percentage score obtained.

Table 1. Likert Scale of Module Validation adapted from Sugiyono (2021)

Score	Category
1	Very Not Good
2	Not Good
3	Quite Good
4	Well
5	Very Good

To calculate the percentage of questionnaire data, a formula like equation (1) can be used.

$$P = \frac{n}{N} \times 100\% \tag{1}$$

P = The percentage of success (%)

n = The total score

N = The maximum score

The percentage of the validation sheet obtained based on the Likert scale will be interpreted with the criteria presented in Table 2.

Table 2. Likert Scale Interpretation adapted from Riduwan & Akdon (2013)

Score (%)	Category
0 - 20	Very Not Valid
21 - 40	Less Valid
41 - 60	Enough Valid
61 - 80	Valid
81 - 100	Very Valid

If the score shows above 61% then the learning module is feasible for the implementation stage. Validated module revisions are also needed based on expert input and suggestions so that the module becomes better and ready to be applied to students.

Result and Discussion

Selection of learning media is important in presenting quality learning activities (Sari et al., 2019). Interactive Module media design uses the ADDIE development model in the form of 5 steps. The first stage is the analysis stage, data on module development requirements were obtained through interviews with fifth grade teachers at Gugus Dewi Kunthi Elementary School, Semarang City.

During the learning process the teacher explains the material using learning resources provided by the school in the form of textbooks and LKS. Teachers have not been able to use learning media because of limited time and teachers only focus on achieving Basic Competence so that learning is less innovative causing the learning process to become boring. Next identify core competencies and basic competencies to develop learning indicators that must be achieved.

The design stage is mapping the media elements and compiling the systematics of the media to be developed, namely interactive modules. The developed modules are arranged using the PBL model stages. Problems used at the PBL stage Problem orientation uses socioscientific issues related to the causes and impacts of water cycle disturbances. So that it can make learning more focused, and train students' thinking skills in analyzing problems and finding solutions.

The elements in the interactive module are also equipped with explanations in the form of video, question and answer games with wordwall applications and three-dimensional animation of the water cycle, which are expected to attract enthusiasm and motivate students in learning. The module to be developed has components namely: cover; subcovers; preface; table of contents, figures and tables; concept map; basic competency mapping; instructions for using the module; material according to PBL stages; practice questions with games; competency test; learning videos; bibliography; and back cover.

The next stage is the development stage, the media that has been designed will be made and then validated by experts. After compiling the material and collecting the required components, interactive module development is designed using the Canva application as shown in Figure 1.

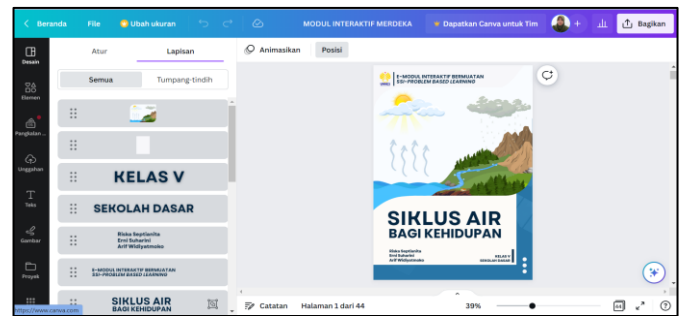


Figure 1. The Module Design Process in Canva

The interactive module is equipped with a links which is used to display learning video. Videos on socioscientific issues containing the impact of the expansion of the Semarang city area into the Gunungpati sub-district on the environment which is displayed via YouTube as shown in Figure 2.



Figure 2. Videos On Socioscientific Issues

Digital games are arranged using water cycle materials and created using the wordwall application as shown in Figure 3. There are two types of digital games, namely hitting terms related to the stages of the water cycle and searching for the correct answers to the questions displayed regarding the water cycle material.



Figure 3. Digital Game Display

Furthermore, a simple three-dimensional animation depicting the process of the water cycle at each stage is made using the Assemblr Studio application as shown in Figure 4.



Figure 4. 3D Animation Display

The interactive module developed is also equipped with practice questions which can be accessed via the quizziz page as shown in Figure 5.

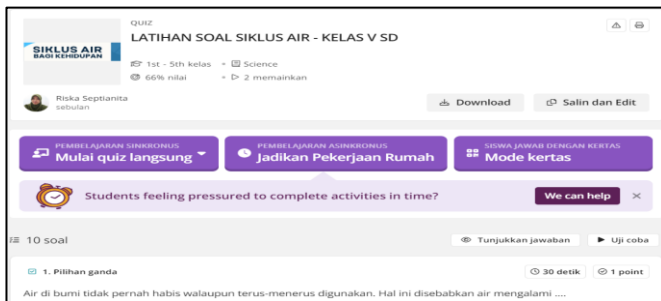


Figure 5. Practice Questions Display



Figure 6. Comic Display

The content section of the interactive module is also equipped with a literacy page which is designed in comic form as shown in Figure 6, so that students are interested in reading the information presented so that it makes the module look more attractive and becomes a differentiator from teaching materials in general.

Interactive modules are displayed digitally using third-party applications, namely heyzine flipbooks as shown in Figure 7. So that apart from being able to print modules, teachers can also use a laptop connected to the internet network to display modules via a projector screen so that they can be directly connected to video, game or animation pages. The development of touch screen-based mobile devices has added to the interactive moving images presented in digital books (Budiaman et al., 2021).



Figure 7. Digital Display of Modules

The interactive module is structured using the five stages of the PBL learning model which is complemented by student worksheets as shown in Table 3.

Table 3. Interactive Module Display in Learning Activities

Information

Stage 1

Problem Based Learning (PBL) Organize students into problems. The problem is presented in the form of a video that can be displayed on a cellphone by scanning a Qrcode.

Interactive Module Display

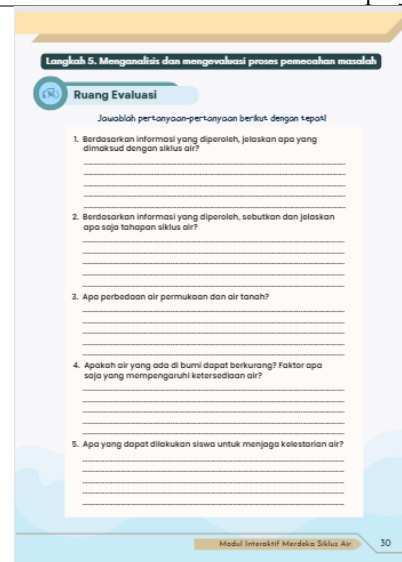


Information

Interactive Module Display

Stage 5

Problem Based Learning (PBL) Analyze and evaluate the problem-solving process. At this stage students answer questions as a form of evaluation of the problem solving process. Then proceed with making conclusions with the teacher.



The interactive module which has been corrected according to the suggestions and input of the reviewers, will be given to three validators with seven lecturers and two teachers to see its feasibility from the aspect of validity consisting of three material expert lecturers to assess content validity, three material expert lecturers, one language expert lecturer, and two Indonesian language teachers to assess construct validity. The interactive module validity test will be seen from the content and construct aspects. The results of the validation can be seen in Table 4.

Table 4. Validation results

Validity	Percentage (%)	Criteria
Content	95.55	Very Valid
Construct	97.52	Very Valid

Table 4 states that the interactive module being developed has a percentage of 95.55% for content validity and 97.52% for construct validity. Where both content and construct validity are included in the very valid criteria, so that interactive modules as learning media can be used as innovations in learning to support digitalization of education by integrating PBL models and approaches to socioscientific issues.

This is in accordance with research conducted by (Rahmatsyah & Dwiningsih, 2021) where the interactive modules they developed were stated to be very feasible and could be a source of student learning after obtaining a percentage of 90% for content validation and obtaining construct validity results with presentation, language and graphic criteria percentage respectively of 93%, 84%, and 100%.

In the research by (Leny et al., 2021; Mahmudah et al., 2022; Susanto et al., 2022) developed digital teaching materials that are applied in learning using the PBL

model stages and instrument questions to measure student learning outcomes. The research results show that digital learning media applied through the PBL model can improve learning outcomes.

Content Validity

Content validity which must include relevance is an interactive module feasibility test based on the suitability of the material and language aspects of the interactive modules. The results of content validity are presented in Table 5.

Table 5. Content Validity

Validity	Percentage (%)	Criteria
Material	96.67	Very Valid
Language	94.44	Very Valid

The selection of basic competencies must be in accordance with the material in the interactive module. The results of content validity on the material aspect which includes the suitability of the material with basic competencies, the suitability of the material with the learning objectives, the sequence of the material, and terms used get a percentage of 96.67% and is included in the very valid category.

From these results it can be stated that the material aspect of content validity in the interactive module is appropriate. The material presented in the interactive module refers to the basic competencies of science class V in the 2013 curriculum, namely the definition of the water cycle, the impact of human activities on the sustainability of the water cycle, and how to maintain the availability of clean water.

The language aspect in content validity got a percentage of 94.44% and included in the very valid criteria, it indicates that the sentences in the module can be understood properly. The suitability of the language

and terms used will affect students understanding of the material. If there are inappropriate language and terms, the reader will have difficulty understanding the intent of the writing.

Construct Validity

Construct validity which includes the consistency aspect is an interactive module feasibility test based on the suitability aspect of the instructional aspect and the presentation aspect of the interactive module. The results of construct validity are presented in Table 6.

Table 6. Construct Validity

Validity	Percentage (%)	Criteria
Media Design	96.42	Very Valid
Presentation	98.61	Very Valid

In the media design aspect, a percentage of 96.42% is obtained with a very valid category. Where the design aspects include the harmony between the color of the text and objects with the background, the colors and images chosen according to the characteristics of elementary school students, the selection of font types and sizes, and the suitability of the images in the video with the material.

The combination of colors makes the appearance of the interactive module attractive, while the right size and type of font will provide comfort when used so as to create a pleasant learning atmosphere. Illustrative images, animations and videos used must also be able to convey the content or message of the images and videos themselves and can complement the material being explained so that they can help students improve their understanding of the water cycle material. With the use of modules arranged using a problem-based learning model that contains content on socio-scientific issues in the everyday environment, it is expected to be able to improve learning outcomes.

In the presentation aspect which includes clear operating guidelines, consistency of navigation buttons, ease of modules to encourage independent learning students to get a percentage of 98.61% and included in the very valid criteria, it shows that the module is able to support students learning independently.

The interactive module developed is to help students learn independently wherever and whenever. If an interactive module does not have an operating guide and has inconsistent navigation buttons, it will certainly make it difficult for users, namely students, to use the module. If students experience difficulties in using the module and operating applications that are integrated in the module, of course students cannot learn independently easily.

Overall, the presentation of the interactive module is very interesting for use in science learning. Further

research can be carried out at the implementation stage to test its effectiveness on student competencies to be achieved (Anggraini et al., 2018).

Conclusion

Interactive modules containing Problem Based Learning with socioscientific issues integrates applications that aim to display videos via the YouTube, digital games with wordwall, 3D animation, practice questions via quizizz and can be displayed digitally with the heyzine flipbook. The water cycle interactive module is structured based on the PBL stages which contain socioscientific issues with the theme of causes and impacts of water cycle disturbances. From the results of data validation and analysis, a percentage of 95.55% was obtained for content validation and a percentage of 97.52% for construct validation, both of which were classified as very valid. From these results it can be concluded that the interactive module containing problem-based learning with socioscientific issues in the water cycle material is feasible to use in terms of validity aspects.

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Author Contributions

The contribution of the authors including Riska Septianita: developing e-modules, conducting validation tests, and writing the original drafts; Erni Suharini and Arif Widiyatmoko: focus on methodology, supervision, and review of writing; Putut Marwoto and Sungkowo Edy: guidance on writing scientific papers.

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Conflicts of Interest

The authors declare no conflict of interest.

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