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Validity Analysis of the OIPE Model Teaching Materials with Experimental Methods to Train Critical Thinking Skills of Elementary School Students

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Abstract: This research was conducted with the aim of obtaining experimental method-oriented OIPE science teaching materials that were suitable to be used to train critical thinking skills and science process skills for elementary school students. The research method used in this study refers to the 4-D development model. The results showed that the results of the development of teaching materials were feasible to be used in elementary school science learning with the following results: the syllabus got a score of 3.7 (very valid), lesson plans got a score of 3.8 (very valid). Validation of teaching materials on the feasibility aspect of content gets a score of 3.8 (very valid), the aspect of presentation feasibility gets a score of 3.7 (very valid), the feasibility aspect of language according to BSNP gets a score of 3.6 (very valid), the aspect of assessing teaching materials with the experimental method-oriented OIPE model gets a score 3.8 (very valid), the feasibility aspect of graphics gets a score of 3.8 (very valid), critical thinking test questions get a score of 3.52 (valid). From the validation results, it can be concluded that the teaching materials to be developed are very suitable for use in elementary school science learning.

Keywords: Critical thinking skills; Experimental methods; OIPE Model; Sains; Teaching Materials

Introduction

The era of globalization that occurs in the 21st century is now an era of intense free competition between countries in the world. The ability to be able to overcome challenges including solving problems critically is an important part of being able to compete with other countries. The development of the 21st Century is marked by the rapid rate of development of technology, science, communication, and transportation. This will also trigger increasingly complicated and complex problems, thus requiring higher-order thinking skills to solve many problems quickly (Saad, 2017).

Based on these needs, the fact shows that the thinking level of Indonesian students has not reached a high level, it is known based on a survey conducted by the Program for International Student Assessment (PISA) in 2018 which shows that the achievement of student competence in Indonesia is ranked 71 out of 79 countries in the field of education science, Indonesia is still in the bottom 10 ranks in the low performance quadrant with high equity and a score of 396 which is far from the international average score, which is 489. PISA divides students' abilities into 6 levels, namely level 1 to level 3. as lower-order thinking skills (Lower Order Thinking Skills) and levels 4 to level 6 are referred to as higher-order thinking skills (Higher Order Thinking Skills) which refers to the cognitive abilities of Bloom's Taxonomy by Anderson and Krathwohl (Apino & Retnawati, 2018).

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A portrait of an elementary school located in Kupang NTT, Indonesia in the learning process, especially science subjects, has so far presented too much knowledge. Students learn science concepts by listening to teacher explanations or reading books, resulting in students' confidence in science not through self-observation but through notifications from others (Aiman et al., 2019). Science is a science that examines everything about phenomena that exist in nature, both living and non-living things, so that science is not only mastery of a collection of knowledge in the form of facts, concepts or principles, but also a process of discovery (Meilani & Aiman, 2020). In learning science, students are taught to equip students to have the knowledge and skills as well as student learning experience, especially for students who experience learning difficulties. Teaching materials can be said to be good if they use learning theories that can support the achievement of basic competencies (Sheridan et al., 2019). The characteristics of the teaching materials include independence, relying on individual differences, the presence of associations, the use of various media, active participation of students, direct reinforcement, supervision of evaluation strategies (Ambarwati et al., 2020).

In creating an active and fun science learning process, teaching materials not only contain material but must also be able to guide students to be active in learning activities and experimenting (Bhakti et.al, 2023), so that students' critical thinking skills can be formed (Sari et al., 2019). Based on the results of observations, in Science Teaching Materials after being analyzed in one of the elementary schools, namely SD GMIT No.7 Oebufu, the presentation of student teaching materials was incomplete. In addition, teaching materials have not implemented the organizing stage. In the organizing phase, students should be directed to learning objectives with examples of authentic phenomena so that they can activate the basic elements of students' critical thinking skills and can connect learning with thinking. Furthermore, according to Naila & Khasna (2021) Science is a topic that requires investigation to obtain data and information about the universe using observational methods and tested hypotheses. Basically, science is viewed from a product, process and attitude development perspective. This means that learning natural science has a process dimension, a product dimension, and a scientific attitude development dimension (Khasna et al., 2022). In line with Sriwahyuni et al., (2019) stating that science is an experimental science, by conducting experiments students not only understand and master concepts and theories, but also apply the scientific method and develop a scientific attitude.

Therefore, innovation is needed to develop teaching materials that are in accordance with the characteristics of science subjects. The OIPE model (organizing, investigating, presenting, and evaluating) with the experimental method is considered to be in accordance with the nature of science learning. Bahtiar (2016) explains that the OIPE learning model is a model designed to improve critical thinking skills based on constructivism theory. The OIPE model invites students to interact directly with the environment and discover concepts independently. Students are guided to construct their knowledge independently through practicum, are trained to solve problems, and play an active role in the learning process. The OIPE model stands for 4 phases (organising, investigating, presenting, and evaluating).

In this case the OIPE model is very suitable when oriented to the experimental method. This suitability is because the P3E model is centered on critical thinking skills through experiments using divergent and convergent thinking processes that emphasize finding various ideas or alternative ideas to find solutions to problems (Laili, 2021). Critical thinking skills are key in education to solve a problem. Critical thinking as a cognitive skill, which includes indicators of interpretation, analysis, evaluation, inference, explanation, self-regulation (Khasna, 2019). Critical thinking skills are the foundational pillars for creating a pathway for Nature of Science (NOS) learning. Science is one of the tools to develop critical thinking ability. Critical thinking is an important and vital topic in modern education era (Sari et al., 2019). A person who thinks critically capable of asking the right questions, gathering relevant information, acting efficiently and creatively based on information, can put forward a logical argument and can make conclusions (Schafersman, 1991). The importance of critical thinking skills is expressed by Demiral (2018) stating that critical thinking makes students think openly, able to formulate problems clearly and precisely, able to collect and assess relevant information, use ideas to interpret effectively a conclusion by providing reasons and solutions, able to communicate effectively with others in finding out solutions to complex problems. Meanwhile, the Experimental Method can train students to seek and find answers or problems themselves by conducting their own experiments and training students to think scientifically (Tortop, 2016). In the experimental method students are given the opportunity by the teacher to experience or do it themselves, prove themselves, follow a process, observe an object, analyze, prove and draw their own conclusions about an object and the state of things (Adiatma, 2018).

Based on the description above, the formulation of the problem in this study is "how is the feasibility of

OIPE-oriented science teaching materials experimental methods to train elementary school students' critical thinking skills and science process skills?".

Method

This research is a type of developmental research with a 4-D model development design consisting of four stages, including defining, designing, developing, and disseminating (Thiagarajan and Sammel, 1974). The choice of this development model is due to the fact that it has clear, coherent design stages, and in accordance with the needs of the development of teaching materials for elementary school students, especially science subjects.

The data acquisition instruments in this study were science teaching material validation sheets and observation sheets. The acquisition method used is the provision of validation sheets, observations, and tests. This research was carried out until the test spread (Disseminate). This research was conducted in class IV SD GMIT No. 7 Oebufu City of Kupang, East Nusa Tenggara. The product resulting from the development is science teaching materials to improve the critical thinking skills of grade IV students.

The teaching materials to be validated include the validation of content eligibility aspects, presentation feasibility aspects, language eligibility aspects according to BSNP (2006), OIPE model teaching material assessment aspects, graphic feasibility aspects, critical thinking skills tests, syllabus, and lesson plan validation results.

Result and Discussion

The validation of teaching materials aims to assess the feasibility of several aspects of teaching materials by experts before being used in learning. Then it is revised according to the suggestions and input from 3 experts and it is hoped that these improvements can produce very valid teaching materials. Aspects that will be validated in teaching materials are aspects of content feasibility, presentation feasibility aspects, language feasibility aspects according to BSNP (2006), OIPE model teaching materials assessment aspects, graphic feasibility aspects, and the results of RPP validation. The validation assessment uses a Likert scale containing a score of 1-4 with a description of the value of 1 being less valid, the value of 2 being quite valid, the value of 3 being valid, and the value of 4 being very valid. As for a brief explanation of the results of the validation of the development of the OIPE model teaching materials oriented to the Experimental Method by 3 experts as follows:

Content Feasibility Aspect

Student Teaching Materials developed in this study contained light material (the properties of light) and were validated by three experts. Aspects assessed include the suitability of the material with basic competencies, accuracy of the material, up-to-date material, encouraging curiosity, in summary, it can be seen in table 1.

Table 1. Results of Validation of Teaching Materials Aspects of Feasibility of Content

Rating Points	Score			Average	Criteria
	V1	V2	V3		
Conformity of Material with Basic Competence	3.6	3.3	3.6	3.5	Valid
Material Accuracy	3.8	3.8	3.8	3.8	Very Valid
Material Update	4	4	4	4	Very Valid
Encourage Curiosity	4	4	3.5	3.8	Very Valid
Average	3.9	3.8	3.8	3.8	Very Valid
Reliability					86%

Validation Results Table 1 obtained information that in general the aspect of the feasibility of the contents of the teaching materials developed by the researchers had an average score of 3.8 with a very valid category. The reliability which was analyzed using Percentages of Agrement reached a percentage of 86%. These results indicate that the assessment criteria of the three validators for each indicator are very valid and reliable, meaning that the feasibility aspect of the content of the OIPE model teaching materials oriented to the experimental method is feasible to be tested in the field.

Aspects of Feasibility of Presentation

As for the presentation feasibility aspect that will be assessed includes presentation techniques, presentation support, learning presentations, and coherence of the flow of thought. In summary, it can be seen in Table 2.

The results of the validation of Table 2 obtained information that in general the aspect of the feasibility of presenting the teaching materials developed by the researchers had an average score of 3.7 with a very valid category. The reliability which was analyzed using Percentages of Agreement reached a percentage of 86%. These results indicate that the assessment criteria of the three validators of each indicator are very valid and reliable, meaning that the aspect of the feasibility of presenting the OIPE model teaching materials oriented to the experimental method is feasible to be tested in the field.

Table 2. Results of Validation of Teaching Materials Aspects of Feasibility of Presentation

Rating Points	Score			Average	Criteria
	V1	V2	V3		
Presentation Technique	4	3	4	3.7	Very Valid
Presentation Support	3.6	3.8	4	3.8	Very Valid
Learning Presentation	4	4	4	4	Very Valid
Coherence and Coherence of Thoughts	3.5	3	3.5	3.3	Valid
Average	3.7	3.5	3.9	3.7	Very Valid
Reliability					86%

Aspects of Language Feasibility According to BSNP

As for the aspects of the feasibility of language according to the BSNP (2006) which will be assessed include straightforwardness, communicative, dialogical and interactive, conformity with the development of students, and conformity with language rules. In summary, it can be seen in Table 3.

Table 3. Validation Results of Teaching Materials Aspects of Language Feasibility

Rating Points	Score			Average	Criteria
	V1	V2	V3		
Straightforward	4	3	4	3.7	Very Valid
Communicative	3.3	3.3	3.7	3.4	Valid
Dialogic and Interactive	4	4	4	4	Very Valid
Suitability with the development of students	3	3.5	3	3.2	Valid
Conformity with language rules	3.5	4	3.5	3.7	Very Valid
Average	3.6	3.6	3.6	3.6	Very Valid
Reliability					86%

Validation Results Table 3 obtained information that in general the feasibility aspect of language according to BSNP (2006) in teaching materials developed by researchers has an average score of 3.6 with a very valid category. The reliability which was analyzed using Percentages of Agreement reached a percentage of 86%. These results indicate that the assessment criteria of the three validators for each indicator are very valid and reliable, meaning that the language feasibility aspect of the experimental method-oriented OIPE teaching materials is feasible to be tested in the field.

Aspects of Assessment of Teaching Materials The OIPE Model is oriented to the Experimental Method

As for the aspect of the assessment of teaching materials, the OIPE model is oriented to the Experimental Method, which will be assessed including Organizing, Investigation, Presentation, and Evaluation. In summary, it can be seen in table 4.

Table 4. Results of Validation of Teaching Materials Aspects of Assessment of the OIPE Model oriented to Experimental Methods

Rating Points	Score			Average	Criteria
	V1	V2	V3		
Organizing	4	4	4	4	Very Valid
Investigation	4	3.8	3.8	3.9	Very Valid
Presentation	3	4	4	3.7	Very Valid
Evaluation	4	3	4	3.7	Very Valid
Average	3.8	3.7	3.9	3.8	Very Valid
Reliability					86%

Validation Results Table 4 obtained information that in general the assessment aspect of the OIPE model oriented to the Experimental Method developed by the researcher had an average score of 3.8 with a very valid category. The reliability which was analyzed using Percentages of Agreement reached a percentage of 86%. These results indicate that the assessment criteria of the three validators for each indicator are very valid and reliable, meaning that the aspect of assessing teaching materials for the OIPE model oriented to the experimental method is feasible to be tested in the field.

Aspect of Feasibility of Graphics

The aspects of the graphic feasibility assessment that will be assessed include book size, cover design, and content design. In summary, it can be seen in Table 5.

Table 5. Validation Results of Teaching Materials Aspects of Feasibility of Graphics

Rating Points	Score			Average	Criteria
	V1	V2	V3		
Scientific Education oriented book size	3.3	3.3	4	3.5	Very Valid
Cover Design	4	3.5	3.5	3.7	Very Valid
Content Design	3.8	3.6	4	3.8	Very Valid
Average	3.8	3.7	3.9	3.8	Very Valid
Reliability					86%

Validation Results in Table 5 obtained information that in general the feasibility aspect of the graph developed by the researcher had an average score of 3.8 with a very valid category. The reliability which was analyzed using Percentages of Agreement reached a

percentage of 86%. These results indicate that the assessment criteria of the three validators of each indicator are very valid and reliable, meaning that the feasibility aspect of graphics is feasible to be tested in the field.

Critical Thinking Skills Test Validity

The test of students' critical thinking skills which was developed in the form of an essay consisted of 6 questions. The critical thinking skills developed were validated by three experts or experts. Aspects of the test assessed by the validator are content, language, and question writing. A summary of the results of the analysis is presented in Table 6.

Table 6. Validity Results of Critical Thinking Skills Test

Question Number	Content Validation			Language and Question Writing			Average	Category
	V1	V2	V3	V1	V2	V3		
1	3	3	3.5	3	3.5	3	3.2	Valid
2	3	3	3	2	4	3	3.0	Valid
3	3	3.5	3	4	3	3	3.3	Valid
4	3	4	4	3	3	3	3.3	Valid
5	3.5	3	3.5	3	3.5	3	3.3	Valid
6	3	3	3	3	3	3	3.0	Valid
Average	2.9	3.0	3.3	3.2	3.1	3.0	3.2	Valid

Validation Results Table 6 obtained information that the validity of the critical thinking skills test developed by the researcher had an average score of 3.2 with a valid category.

Syllabus Validation Results

The syllabus developed by the researcher refers to the analysis of student characteristics and the 2013 Curriculum format by considering the breadth of the material, and the time allocation made in 2 meetings. The syllabus that has been developed by the researcher is then validated by 3 experts with the results that can be seen in Table 7.

Table 7. Syllabus Validation Results

Aspect	Score			Average	Criteria
	V1	V2	V3		
Contents	3.4	3.6	3.6	3.5	Valid
Language	3.5	3.4	3.5	3.5	Valid
Time	3.8	4	4	3.9	Very Valid
Average	3.6	3.7	3.7	3.7	Very Valid
Reliability					86%

The results of the validity of the syllabus are in Table 7, the results obtained that in general the syllabus developed has a very valid category with an average score of 3.7 with a reliability level of 86%. So that the syllabus developed is suitable for use by teachers in learning with revisions and can be used as a reference in lesson plans. This is stated in Permendikbud No. 65 of 2013 concerning process standards, the syllabus is a reference for the preparation of the learning framework for each subject study material.

Learning Implementation Plan Validation Results

Based on the assessments made by 3 experts or experts, the results of the RPP validation. The results of the validity of the Learning Implementation Plan can be briefly seen in Table 8.

Based on the results of the RPP validation analysis, it shows that the average score for the validity of the RPP is 3.8 with a very valid category and the reliability level obtained from the validator is 86%. From the results of the analysis, it can be concluded that the lesson plans developed are very valid for use in learning. The learning model applied in this lesson plan is the OIPE model oriented to the experimental method to convey material about the Properties of Light. Based on the Ministry of Education and Culture (2013), the lesson plans are arranged so that learning takes place interactively, inspiring, fun, efficiently, motivating students to participate actively, creatively, and encouraging students to be able to study and work independently according to their talents, interests, and physical and psychological development of the student.

Table 8. Result of RPP Validation

Aspect	Score			Avera ge	Criteria
	V1	V2	V3		
Contents	3.4	3.6	3.6	3.5	Valid
Language	3.5	3.4	3.5	3.5	Valid
Time	3.8	4	4	3.9	Very Valid
Average	3.6	3.7	3.7	3.7	Very Valid

Validation is an activity of obtaining approval or validation of a device based on conformity with the required criteria. The teaching materials developed will later be used by students as references and learning resources for students (Ridho et al., 2020). Teaching material can be declared valid if all of its components meet the minimum valid criteria. Teaching material validation is a process carried out to test the suitability of teaching materials with competencies that are used as learning targets. Data validity results from the several

tables above show a valid category, and it is feasible to be tested in the field because it has paid attention to the accuracy and validity of the elements involved (Trianto, 2014).

The validation of teaching materials on the content feasibility aspect obtained an average score of 3.8 with a very valid category. The validation of teaching materials for the feasibility aspect of the presentation obtained an average score of 3.7 with a very valid category. In the aspect of language feasibility according to BSNP (2006), it obtained an average score of 3.6 with a very valid category. The evaluation aspect of the P3E model is oriented towards experimental methods and the graphical aspect obtains an average score of 3.8 with a very valid category. On the critical thinking skills test, an average score of 3.2 is obtained with a valid category. And on the results of the validation of the learning implementation plan, it obtained an average score of 3.8 with a very valid category. In this case, the tools and teaching materials developed with the experimental method-oriented P3E model were deemed feasible and appropriate according to the validator.

The teaching materials were declared valid by the validator because the composition of the learning teaching materials developed had met the requirements for the preparation of good learning teaching materials. The aspects that have been observed include aspects that will be validated in teaching materials, namely content eligibility aspects, presentation feasibility aspects, language eligibility aspects according to BSNP (2006), OIPE model teaching material assessment aspects, graphic feasibility aspects, critical thinking skills test validity, syllabus validation results, and RPP validation results.

Conclusion

The results of the development of the OIPE model teaching materials oriented to the experimental method are suitable for use in learning science for elementary school students who have been declared very valid by experts or experts by fulfilling the elements of validity in content and constructs.

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