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Assessment of Creative Thinking Skills through Imitation, Modification, and Construction of Creative Thinking Models

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ABSTRACT

Creative thinking is an ability that must be possessed by every student being capable of resolving issues in various ways that are right. Creative thinking is one of the goals of education that has become a concern in recent years. But the facts show that the ability to think creatively is still low. The main thing that educators do is to identify the level of creative thinking of students so that educators know which students ' creative thinking skills need to be improved. Until now, the ability of educators in developing creative thinking ability tests is still low due to the lack of training and guidance that focuses on improving creative thinking skills. The aim of this research is to generate a product in the form of a test instrument of creative thinking skills that are valid, practical and effective. This research is a development research conducted with 4D models (Define, Design, Develop, Disseminate), but the disseminate stage is not carried out due to time and cost constraints. The development phase was carried out on 88 students of grade VIII of One of the private high schools in Malang . The development results show that the creative thinking ability test is valid, practical and effective.

Keywords: assessment; creative thinking; development; imitation; modification

INTRODUCTION

Education is a major investment in human resources, providing numerous direct and indirect benefits. The changing times impact the development of science, which is influenced by thinking abilities, including creative thinking (Arifudin, 2022; (Ritter et al., 2020; Thornhill-Miller et al., 2023; Vincent-Lancrin, 2021). This aligns with the opinion of Wahyuni and Palupi (2022), who state that creative thinking is a diverse skill that needs to be developed in all subjects, particularly in mathematics learning at school. According to Bloom's revised taxonomy, creating is the highest component for performing mathematical activities that demand creative thinking. In line with the opinion of Handayani et al. (2020), school learning plays a crucial role in fostering students' creative thinking abilities. To solve mathematical problems requires thinking skills, one of which is the ability to think creatively. However, in reality, students' creative thinking skills are still low. This is based on several research results which state that the creative thinking ability of children in Indonesia is still low (Kamalia & Ruli, 2022; Maryati & Parani, 2021; Samudera et al. 2023). Based on the results of the study, it is stated that the creative thinking ability of junior high school students on flat-sided space building material is in the low category (Apriansyah & Ramdani, 2018). Another study wrote that the mathematical creative thinking ability of high school students in trigonometry material is also still low (Trisnawati et al., 2018). Meanwhile, creative thinking is also an important aspect in the learning process, this is in accordance with research which says that creative thinking is needed in learning which aims

to make it easier for students to solve math learning problems (Saidah et al., 2020). . This research is important to help teachers know the creative thinking abilities of students, so that teachers can provide material to students according to their respective levels of thinking ability

Creative thinking occurs when learners can solve problems in various correct ways or in ways that are different from others. This aligns with the opinion that creative thinking is the student's capacity to identify unique, unusual solutions that have never been discovered by others (Lee et al, 2023; Purwasih, 2019). Several studies indicate that students' creative thinking abilities are low. This is supported by research findings that junior high school students' creative thinking skills in flat-sided geometry are in the low category (Apriansyah & Ramdani, 2018). Similarly, Trisnawati et al. (2018) found that the creative thinking abilities of high school students in trigonometry are also even now. Then Based on Trisnawati, et al (2018) produced a study that wrote that the ability to think creatively mathematically high school students in trigonometry material is also still low. From unstructured interviews with Junior High School math teachers at two private junior high schools in Malang, Indonesia, it was found that teachers have not yet conducted assessments of students' creative thinking abilities. Based on research Yenti et al. (2023) creative thinking can be generated by working on problems, the teachers emphasized that fostering creative thinking is crucial for solving everyday life problems. However, if creative thinking skills are taught without being assessed, the effectiveness of this instruction cannot be measured. Assessment is an essential activity to gauge students' abilities. This aligns with the perspective that national assessments are conducted to monitor and evaluate the quality of the education system (Purnomo et al., 2022; Zhou, 2023).

Assessment of creative thinking skills needs to be implemented because the level of thinking of students will affect the learning process conducted at school. This is in line with the opinion of Purnomo et al., (2023) which states that the importance of exploring students' creative thinking in numeracy can support policies in implementing the Minimum Competency Assessment in Indonesia. Based on the level of thinking taxonomy, Bloom explained that a person is not clever and stupid but is classified into six levels. It aims to make the assessment more specific, easy in preparing assessments on the curriculum, and easy in preparing teaching instructions. So far the study of creative thinking classify students into 3 groups, namely high, medium low (Gumalangit & Achmad, 2023) and according to the study that was done by Handayani and Hasanah (2024) students are classified into 5 levels of creative thinking, namely very creative, creative, quite creative, less creative, and not creative. however, in this study, the classification of creative thinking skills of students using framework adaptation creative model Imitasi, modification, and construction (Subanji dkk., 2021). This study uses Guilford indicator with weight assessment system for each indicator is Fluency with a weight of 2, Flexibility with a weight of 3, Originality with a weight of 4 and Elaboration with a weight of 1. This is in line with Gardner's opinion (2010) that there are no stupid or smart children, there are children who stand out in one or more types of intelligence. Likewise, in the ability to think creatively, there are no students who are creative and not creative.

However, research and discussions by Suwandani et al. (2020) concluded that one significant challenge teachers face in carrying out authentic assessments is the difficulty in

creating and developing assessment instruments. This underscores the importance of developing test instruments for creative thinking abilities. One solution to address this challenge is to assist teachers in developing assessment instruments and measuring learners' creative thinking skills using a specific, easy-to-categorize assessment rubric. Assessment is a structured method of collecting, processing, and utilizing data on cognitive and non-cognitive aspects to raise the standard of instruction for students (Kemendikbud, 2020). Therefore, assessment is a crucial aspect of the learning process. Based on these issues, this research seeks to establish a valid, practical, and effective assessment of creative thinking.

RESEARCH METHODS

This study was a research development (Research and Development). The development model used was the 4D model, consisting of four phases: define, design, develop, and disseminate (Thiagarajan, 1974). The study began with the define stage, where the analysis of existing needs at one of private schools in Malang, was conducted through unstructured interviews with 8th-grade math teachers. Following this, an analysis was performed related to the expected learning achievements (CP) and the topics to be discussed in product development. Evaluation of learning achievements was also conducted. After determining the results, the next stage, the design stage, was initiated.

In the design stage, detailed planning and structuring of the test for creative thinking skills were conducted. This included the development of an assessment rubric and the formulation of alternative answers. The focus was on designing a comprehensive prototype that could be further developed into a creative thinking skills test. This stage involved the creation of initial drafts, detailed outlines, and the necessary components for the test, ensuring they align with the educational objectives and expected learning outcomes.

Following the prototype design, product development was carried out at the development stage. During this stage, the prototype draft was developed into a creative thinking ability test, comprising seven questions on flat building materials along with scoring rubrics. The produced items were then validated by the main validator and experimental validator. The main validator was a mathematics education lecturer, and the experimental validation was conducted by another mathematics education lecturer and a mathematics teacher.

Product validation in this development used a Likert scale of 1-4. The validation instrument consisted of eight items for validating the creative thinking ability test and six items for validating the assessment rubric. Products deemed valid by the expert validator were then tested on 88 students in eighth grade at one Junior High School in Malang. Data collection techniques included tests and questionnaires. After testing, an analysis of the product test results was conducted to ascertain the validity, practicality, and effectiveness of the product.

Data analysis techniques used included item validity tests, power difference tests, reliability tests, practicality tests, inter-rater reliability tests, and difficulty tests. The item validity test was conducted to measure the instrument's accuracy in assessing the ability to think creatively. The validity of the items was tested using Pearson's product-moment correlation (Lestari & Yudhanegara, 2015). The reliability test in this study was performed to determine if the assessment demonstrated consistency when used repeatedly. Cronbach's

alpha coefficient was employed for the reliability test. Given that the test instrument was subjective, a power difference test was conducted using the Corrected Item-Total Correlation formula (Cureton, 1966; Henrysson, 1963). The difficulty level test measured how high the difficulty index of the creative thinking ability test was, using the Equivalency Index formula (Fauzie et al., 2021; Lestari & Yudhanegara, 2015; Pada et al., 2016). The inter-rater reliability test was used to measure the agreement between two or more raters, employing the Kappa index (Kimel & Revicki, 2023).

RESULTS AND DISCUSSION

The results of this study are presented in accordance with the phases 4D (Define, Design, Develop, Disseminate)

Define

At this phases, researchers have reviewed literature related to instrument development and creative thinking. researchers have also carried out unstructured conversations with mathematics teachers and reviewed literature related to research that has been done before. Considering the outcomes of preliminary studies and literature studies, it was found that the capacity for thought creatively in schools has not reached the assessment stage, therefore the assessment of creative thinking skills needs to be developed and to support the accomplishment of the educational process. Then determine the achievement of learning in Phase D (generally for Class VII, VIII and IX SMP/MTs/Package B) geometry elements of one of the flat figures studied in it. Creative thinking skills that focus in research is creative thinking with Guilford indicators namely Fluency, Flexibility, Originality and Elaboration. This test instrument is intended for junior high school students (SMP). for flat building material used in this test instrument is the material that has been taught in eighth grade.

Design

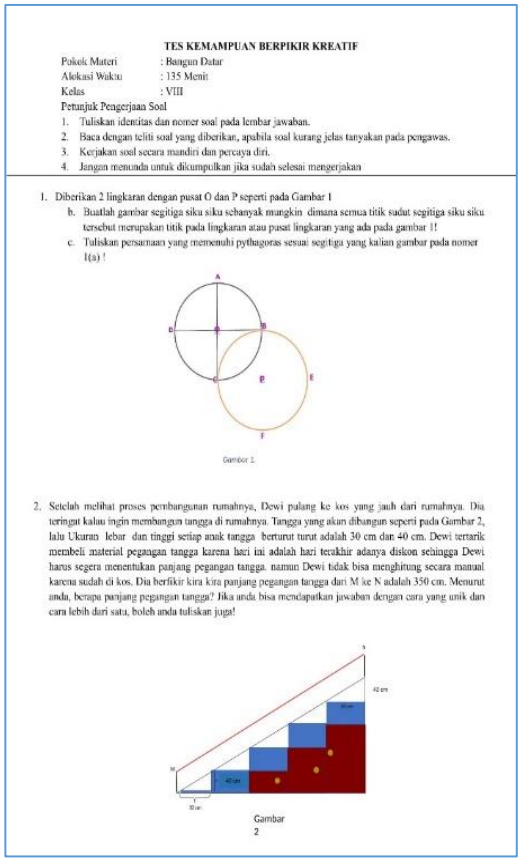
At this phase researchers designed research instruments, validation sheets, creative thinking ability tests and scoring rubrics. Researchers designed indicators used to develop creative thinking ability tests, determine the types of tests used and design scoring rubric criteria. At this stage, researchers also designed research instruments in the form of questionnaires and product validation sheets used in research. In grouping the ability to think creatively, the research conducted is different from previous research which uses the Level of Creative Thinking Ability (TKBK) into 3 groups, namely high, medium low (Gumalangit & Achmad, 2023). Based on research conducted by that students are classified into 5 levels of creative thinking, namely very creative, creative, creative enough, less creative and not creative (Handayani & Hasanah, 2024). But in this study, the classification of students' creative thinking abilities uses the adaptation of the creative model framework Imitation, Modification, and Construction (Subanji et al., 2021).

Develop

At this phase, researchers developed the creative thinking ability test instrument obtained as many as 7 items of essay questions about open problems (open ended problem) arranged based on flat building material. Each question contains 4 indicators of creative thinking ability (Fluency, Flexibility, Originality, Elaboration). Considering the results of expert judgment validation results obtained validation instrument validity and product validation sheet research. Instrument validation results the validity of research instruments

obtained an average of 3.66. Considering the criteria of validity, the research instrument is declared valid and feasible to be tested.

In this study the validity of the product is validated by 3 experts, namely 1 Main validator and 2 supporting validators. The main Validator is carried out before the trial product and 2 supporting validators are carried out while the trial is in progress. Based on the validation results of the creative thinking ability test of the three expert validators obtained an average of 3.54 with the average of each validator is (3.25), (3.87) and (3.5). Considering the criteria of validity of the creative thinking ability test instrument and with an average of 3.54, the creative thinking ability test instrument is declared valid and feasible to use. In addition to the test instruments, the scoring rubric was also validated by the three expert validators. Considering the outcomes of validation rubric scoring by the three validators acquired an average of 3.71 with the average of each validator is (3.66), (3.83) and (3.66). Based on the criteria of validity of the scoring rubric and with an average of 3, 71 then the scoring rubric is declared valid and feasible to use. However, there are suggestions for revision from the main validator regarding the creative thinking ability test, namely on question number 6 related to the editorial writing, after the revision is made, the product will be tested. Here the product that be developed and you can see on Figure 1, Figure 2 and Figure 3.



TES KEMAMPUAN BERPIKIR KREATIF

Pokok Materi : Bangun Datar
Alokasi Waktu : 135 Menit
Kelas : VIII

Petunjuk Pengerjaan Soal

1. Tuliskan identitas dan nomer soal pada lembar jawaban.
2. Baca dengan teliti soal yang diberikan, apabila soal kurang jelas tanyakan pada pengawas.
3. Kerjakan soal secara mandiri dan percaya diri.
4. Jangan menunda untuk dikumpulkan jika sudah selesai mengerjakan

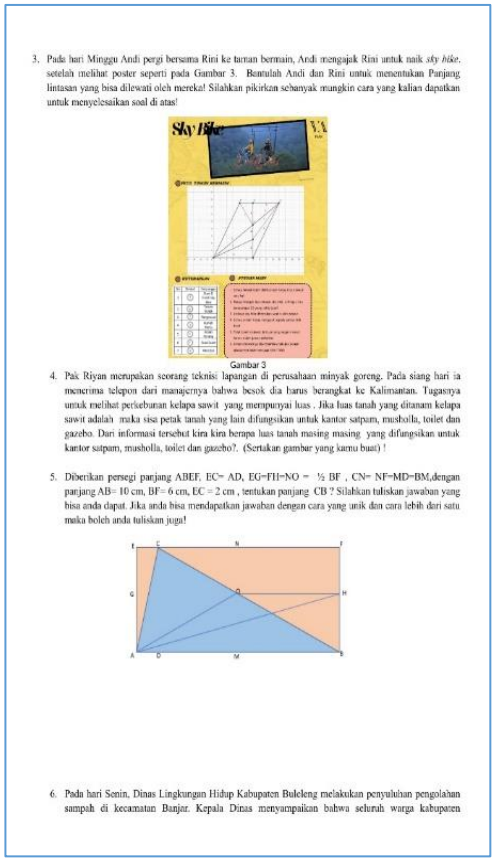
1. Diberikan 2 lingkaran dengan pusat O dan P seperti pada Gambar 1
   b. Buatlah gambar segitiga siku siku sebanyak mungkin dimana semua titik sudut segitiga siku siku tersebut merupakan titik pada lingkaran atau pusat lingkaran yang ada pada gambar 1!
   c. Tuliskan persamaan yang memenuhi pythagoras sesuai segitiga yang kalian gambar pada nomer 1(a) !

Gambar 1

2. Setelah melihat proses pembangunan rumahnya, Dewi pulang ke kos yang jauh dari rumahnya. Dia teringat kalau ingin membangun tangga di rumahnya. Tangga yang akan dibangun seperti pada Gambar 2, lalu Ukuran lebar dan tinggi setiap anak tangga berturut turut adalah 30 cm dan 40 cm. Dewi tertarik membeli material pegangan tangga karena hari ini adalah hari terakhir adanya diskon sehingga Dewi harus segera menentukan panjang pegangan tangga. namun Dewi tidak bisa menghitung secara manual karena sudah di kos. Dia berfikir kira kira panjang pegangan tangga dari M ke N adalah 350 cm. Menurut anda, berapa panjang pegangan tangga? Jika anda bisa mendapatkan jawaban dengan cara yang unik dan cara lebih dari satu, boleh anda tuliskan juga!

Gambar 2

Figure 1. Creative Thinking Ability Test (1)



3. Pada hari Minggu Andi pergi bersama Rini ke taman bermain, Andi mengajak Rini untuk naik *sky bike*. setelah melihat poster seperti pada Gambar 3. Bantulah Andi dan Rini untuk menentukan Panjang lintasan yang bisa dilewati oleh mereka! Silahkan pikirkan sebanyak mungkin cara yang kalian dapatkan untuk menyelesaikan soal di atas!

Gambar 3

4. Pak Riyan merupakan seorang teknisi lapangan di perusahaan minyak goreng. Pada siang hari ia menerima telepon dari manajernya bahwa besok dia harus berangkat ke Kalimantan. Tugasnya untuk melihat perkebunan kelapa sawit yang mempunyai luas . Jika luas tanah yang ditanam kelapa sawit adalah maka sisa petak tanah yang lain difungsikan untuk kantor satpam, musholla, toilet dan gazeba. Dari informasi tersebut kira kira berapa luas tanah masing masing yang difungsikan untuk kantor satpam, musholla, toilet dan gazebo?. (Sertakan gambar yang kamu buat) !

5. Diberikan persegi panjang ABEF, EC= AD, EG=FH=NO = ½ BF , CN= NF=MD=BM,dengan panjang AB= 10 cm, BF= 6 cm, EC = 2 cm , tentukan panjang CB ? Silahkan tuliskan jawaban yang bisa anda dapat. Jika anda bisa mendapatkan jawaban dengan cara yang unik dan cara lebih dari satu maka boleh anda tuliskan juga!

6. Pada hari Senin, Dinas Lingkungan Hidup Kabupaten Buleleng melakukan penyuluhan pengolahan sampah di kecamatan Banjar. Kepala Dinas menyampaikan bahwa seluruh warga kabupaten

Figure 2. Creative Thinking Ability Test (2)

Buleleng diwajibkan untuk membuat lubang biopori seperti pada Gambar 4 yang bertujuan untuk mengurangi penumpukan dan pembakaran sampah. Berdasarkan materi yang disampaikan oleh Kepala Dinas, ukuran diameter pipa lubang biopori yaitu 10-30 cm dan jarak antar lubang biopori 50- 100 cm. Salah satu warga kecamatan Banjar yaitu Pak Tejo ingin segera membuat lubang biopori sehingga Pak Tejo menyuruh tukang kebun untuk membuatnya, Kebun Pak Tejo berbentuk persegi dan luasnya adalah . Pak Tejo akan berangkat ke Bali sehingga Pak Tejo berpesan bahwa pak Tejo ingin membuat lubang biopori sebanyak 8 yang berdiameter 10-30 cm, untuk jarak antara 2 lubang biopori adalah 50 cm.

Gambar . 4. Biopori

Hitunglah luas tanah yang tidak tertanam lubang biopori! Buatlah juga dalam bentuk sketsa. Silahkan tuliskan jawaban yang bisa anda dapat. Jika anda bisa mendapatkan jawaban dengan cara yang unik dan cara lebih dari satu maka boleh anda tuliskan juga!

7. Bu Vina memberikan instruksi untuk menggambar segitiga siku siku ABC yang mempunyai luas dengan ukuran tinggi nya 4 cm. Ratih menyatakan bahwa segitiga ABC tidak mungkin dibuat menjadi segitiga siku siku karena menurut Ratih sesuai teori tripel Pythagoras jika tinggi nya 4 maka sisi lainya 3 dan sisi miring nya 5 seperti pada Gambar 5 maka luasnya adalah . Menurut anda, apakah jawaban dari Ratih benar? Jika benar berikan penjelasanya! Jika tidak, maka berikan jawaban yang benar! Silahkan tuliskan jawaban yang bisa anda dapat. Jika anda bisa mendapatkan jawaban dengan cara yang unik dan cara lebih dari satu maka boleh anda tuliskan juga (Sertakan gambar yang kamu buat) !

Gambar 5

Figure 1. Creative Thinking Ability Test (3)

At this phase, the product was tested on 88 students of Class VII of One of the private high schools in Malang. However, of the 88 students, there were 67 students who designed to take the test, and 21 students did not collect the results of the work. The test results were then analyzed to determine the validity of the item question, practicality, reliability, power difference, level of difficulty, and inter-rater reliability assessment. Validity test, considering the validity test item about the outcome obtained as follows.

Figure 4. Validity Test (Correlation Coefficient)

Based on Figure 4, we conclude seven question about the correlation coefficient there are 1 question is low, 1 question is medium 3 question are high, and 2 question are very high. It is decided that 2 questions are very appropriate in measuring the ability to think

creatively, 3 questions are appropriate in measuring the ability to think creatively, 1 question is quite appropriate in measuring the ability to think creatively and 1 question is not appropriate in measuring the ability to think creatively.

Practical test, Considering the results of questionnaires distributed to students, obtained the following results.

Table 1. Practicality Test Results

Total score obtained	3318
maximum score	52
percentage	63.8

Based on Table 1, it was found that the test instruments used were declared practical with a practicality of 64%.

Based on the reliability test results using alpha cronbach obtained R or reliability coefficient of 0.761 as follows.

Table 2. Reliability Test Results

Reliability Statistics	
Cronbach's Alpha	N of Items
0.761	7

The correlation coefficient of reliability is then interpreted with the reliability interpretation table. Based on Table 2, it can be concluded that the creative thinking ability test instrument has high reliability and does not change if the test instrument will be used repeatedly.

Based on the analysis of different power test instruments creative thinking ability test obtained the following results.

Table 3. Different Power Test Results

No Test	different power	Criteria
1	0.197	Bad
2	0.252	Enough
3	0.452	Enough
4	0.627	Good
5	0.658	Good
6	0.606	Good
7	0.621	Good

After analyzing the difference power test, it can be concluded that 6 questions can distinguish high, medium and low ability students. while Problem Number 1 can not distinguish the ability to think creatively students.

Considering the results of the difficulty level test that has been done, the following results are obtained.

Table 4. Test Result Difficulty

	Level	No 1	No 2	No 3	No 4	No 5	No 6
NO IK	0.57	0.48	0.44	0.41	0.40	0.27	0.18
	moderate	Medium	moderate	Medium	moderate	difficult	difficult

Based on table 4, it was found that 5 problems were stated to be medium and 2 problems were difficult.

Inter Rater Reliability test, based on the results of the inter rater reliability test using cohen kappa, obtained a k value of 0.668 and based on the K Value table, it is stated that the assessment usedis good, which means that the two raters have a good agreement in assessing.

This assessment can also distinguish students into three creative thinking groups as follows.

Table 5. Creative Thinking Level Grouping Results.

Class	category		
	imitation	modified	construction
8C	6	11	0
8D	13	11	0
8F	11	10	0

At this stage, product revision is also carried out after the trial, and based on the suggestions of the results of the difference test, question number 1 will be deleted or removed from the test because question number 1 cannot distinguish students' creative thinking abilities. So that in this study the creative thinking ability test which was originally 7 description questions became 6 description questions.

The resulting test instrument is a creative thinking ability test instrument with 7 items along with the scoring rubric and alternative answers that have been compiled, in this study the scoring rubric uses assessment weights so that the assessment is more precise. To produce the right decision, of course, it is supported by ideal weights. (Mesran dkk., 2019) While previous research did not use scoring weights weights (Busyairi, 2021; Haryanti & Saputra, 2019).

Considering the results of this development research that has been presented, it shows that the test items developed are valid, practical and effective. The validity of the test questions and scoring rubric was obtained from expert validation before being tested. The validity of the test items was declared successful to measure the ability to think creatively obtained from the test results and then analyzed using product moment correlation, of the seven test questions, 1 test was declared unable to measure students' creative thinking skills. This can be caused because in question number 1 students are only presented with a test on the concept and formula of pythagoras and it is easy for students to work on test question number 1, this is also in accordance with the test results of the difficulty level at number 1 of 0.57, it means that question number 1 is easy for students. While the practicality of the test questions is obtained from the results of the analysis of the practicality questionnaire given to students with a practicality test result of 64% and declared practical.

In this study, the effectiveness of the development of this instrument can be seen from the results of the test of differentiation, difficulty level, inter rater reliability and reliability test, that from the results of the analysis it can measure and categorize students' creative thinking abilities into three categories of creative thinking levels. while the previous study only measured the validity and reliability of the instrument as in the research conducted by (Faresta et al., 2020; Warodiah et al., 2023), and overall the development of test instruments was declared valid, practical and effective.

From the results of the analysis of grouping the level of creative thinking ability, it was found that 53.7% of students were at the imitation level, 46.2% of students were at the modification level, and no students were at the construction level. this shows that students' creative thinking abilities still need special attention. This research instrument is declared

reliable so that it can be used by teachers to measure students' creative thinking skills after getting special treatment in the learning process. However, this study has the following limitations: (1) the small number of samples and (2) not doing the dissemination stage. So that further research is needed to find out the evaluation of the instrument after the completion of all stages of research.

Figure 5. Evaluation

Disseminate

At this stage, no dissemination is carried out because researchers only focus on the results of products that are valid, practical and effective as well as limited cost and time.

CONCLUSION

Considering the results of the analysis, a valid research product with a validity value of 3.54 for the creative thinking ability test and 3.71 for the scoring rubric. The research product was also declared practical with a practical percentage of 68%. Based on the results of different power test, reliability test, difficulty level and inter rater reliability, the product was declared effective in categorizing students ' creative thinking skills based on the level of imitation, modification and construction creative thinking. However, due to time and cost constraints, this research only stopped at the development stage.

This research has a good impact for teachers, because this research can help teachers to assess students' creative thinking skills, this is practical because teachers can easily give the tests without any specific requirements for teachers or students. The development of creative thinking ability test instrument is expected to be one of the supporters of creative thinking ability assessment. Researchers suggest that the further development of creative thinking ability test instruments, such as the development of creative thinking ability test instruments on other materials and make test instruments more attractive so that students can work on instruments without coercion so that test instruments can be used properly.

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