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Development of TPACK-Integrated Creative Problem Solving Model in Improving Higher Order Thinking Skills

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Abstract: Development of TPACK-integrated Creative Problem Solving Model in Improving Higher Order Thinking Skills. Objective: This study aims to develop creative problem solving model integrated TPACK to improve higher order thinking skills. **Methods**: This research is Borg & Gall development with sample was 35 students of class XI SMAN 2 Selong. Research instruments is validation guidelines, practicality questionnaires and higher integral material essay tests. Data analysis using descriptive analysis for validity, practicality and t test for effectiveness. **Findings**: Products in the category are valid according to experts materials, language and learning technology. The product is relatively practical with an average score of 82.63. The product is classified effective with $t_{count} = 98.54 > t_{table} = 2.03$ with $\alpha = 5\%$ and n-gain value of 0.77 with high category. **Conclusion**: CPS model integrated TPACK has effective potential to improve higher order thinking skills.

Keywords: TPACK, creative problem solving, high order thinking skills.

Abstrak: Pengembangan Model Creative Problem Solving Terintegrasi TPACK untuk Meningkatkan Keterampilan Berpikir Tingkat Tinggi. Tujuan: *Penelitian ini bertujuan untuk mengembangkan Pembelajaran Creative Problem Solving terintegrasi TPACK untuk meningkatkan kemapuan berpikir tingkat tinggi siswa.* ***Metode:*** *Penelitian ini adalah penelitian pengembangan Borg & Gall. Sampel penelitian adalah 35 siswa kelas XI SMAN 2 Selong. Instrumen penelitian meliputi pedoman validasi desain pembelajaran , kuesioner kepraktisan dan tes esay materi integral. Analisis data menggunakan analisis deskriptif untuk analisis kevalidan, kepraktisan produk dan uji t untuk keefektifan produk.* ***Temuan:*** *Produk dalam kategori valid menurut ahli materi, Bahasa dan teknologi pembelajaran. Produk juga tergolong praktis dengan skor rata-rata 82,63. Produk tergolong efektif dengan* $t_{hitung} = 98{,}54 > t_{tabel} = 2{,}03$ *dengan* $\alpha = 5\%$ *serta nilai n-gain sebesar 0,77 dengan kategori tinggi.* ***Kesimpulan:*** *Model pembelajaran CPS terintegrasi TPACK memiliki potensi efektif untuk meningkatkan keterampilan berpikir tingkat tinggi*

Kata kunci: *TPACK, penyelesaian masalah kreatif, keterampilan berpikir tingkat tinggi.*

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INTRODUCTION

Teachers as educators at the unit level of early childhood, primary, and secondary education have a very important role in determining the success of students so that they become determinants of improving the quality of education in schools. Formal education in Indonesia currently does not emphasize how to develop higher order thinking skills (Yanti, 2019). According to a TIMSS study in 2015, it states that Indonesian students' mathematics ability in the field of mathematics is still far from other countries, which is ranked 44 out of 49 countries (Mullis, 2016). Similarly, from the results of the PISA survey in 2015, the high order thinking skills of elementary and junior high school students in Indonesia is still low (OECD, 2016). Facing these problems, it is necessary to carry out learning that is able to actively involve students in learning so that students are able to explore ideas by utilizing technology so that concepts and strategies are obtained in solving mathematical problems (Khaulah, 2018; Yen, 2015).

Developing higher order thinking skills is an important part of learning (Waluyo, 2020). In mathematics learning, developing high order thinking skills is an activity that is difficult for students to do (Khatimah, 2019). High order thinking requires students to think so that they can find different ways to solve the real problems of mathematics at hand. Higher order thinking skills are skills in using the knowledge possessed by a person to find answers to the problems encountered (Conklin, 2012). Higher order thinking skills are activities in finding solutions to problems by involving knowledge, insight and experience (Richland, 2015). Higher order thinking skills as a skill in using knowledge possessed or previously known to solve problems (Septian 2019). Rahmani (2018) states that through higher order thinking skills, students can find various possible problem solving through the interrelationship of the different fields of knowledge they have learned.

Based on the foregoing, one of the learning strategies that teachers need to go through that are able to teach students actively and have the potential to improve students' higher-order thinking skills is the application of a creative problem solving model. Treffinger & Isaksen (2005) states that one of the learning models that can be used to support learning to think is creative problem solving. Creative problem solving (CPS) is learning that trains students to use their thinking skills in solving problems by considering various possible solutions that arise from students' ideas, as well as being able to improve students' positive attitudes during learning (Hu, 2017). This is also supported by Chant (2009) who states that the CPS model is used in learning that emphasizes critical thinking skills and metacognitive strategies. CPS is the thinking ability that students have and serves to improve the ability to think in a high order in solving problems (Puccio, 2005). The use of CPS facilitates the process of solving certain problems so as to provide space for increased creativity in solving problems (Adams, 2010). The CPS learning model is a learning model that focuses on learning and problem-solving skills, followed by strengthening skills (Nguyen, 2017). Based on previous experience, when students are faced with a new problem, students can select and develop previously acquired ideas, use problem-solving skills and develop higher-order thought processes (Pepkin, 2004).

The CPS model learning is different from traditional learning which is mostly teacher centered, but focuses on learning creativity so that it can be considered a learning model with integrated knowledge, and not only emphasizes active students learning but also emphasizes the togetherness of teachers and students in planning learning activities (Hu, 2017; Tseng, 2015). The same thing is also stated by Su (2016) that CPS learning will also encourage students to think critically by considering various solution options and coming up with new strategies in solving problems. Furthermore, Isaksen and Aerts (2011) state that individuals who learn to use CPS have clear references regarding problem-solving tools and methods that involve creative thinking effectively.

The development of information and communication technology has had a major influence on the learning process of the 21st century and encouraged teachers to have knowledge related to information and communication technology. Facing the development of technology in today's 21st century learning, teachers are required to have technological, pedagogical, content knowledge (TPACK) knowledge that is able to integrate technology in learning, especially learning in schools today must follow the adaptation of new habits due to the Covid-19 pandemic. TPACK is a new type of knowledge that teachers must acquire to be able to integrate technology well in learning (Mishra & Koehler, 2006). TPACK is the transformation of knowledge, content and pedagogical knowledge into different types of knowledge used to develop and implement teaching strategies (Tuithof, 2021). In learning, teachers must have the necessary competencies in integrating technology appropriately and effectively (Akturk, 2019). Koehler, Mishra, & Cain (2013) stated that TPACK is a framework used to analyze the integration of technology in teacher learning.

The TPACK integrated CPS learning model is a CPS learning model where in every step learning is integrated with the use of technology. Some literature search results show the advantages of learning the creative problem solving model. The advantages of CPS learning include training students' thinking skills, training students to solve problems systematically (Kandemir & Gür, 2009), and focusing on learning creativity (Hu, 2017). Yurdakul (2012), revealed in his study that pre-service teachers need to provide opportunities to gain practical knowledge and skills to use the latest technology during the teaching and learning process. Almada (2014), explained in their study that the integration of technology in the classroom depends on the ability of teachers to educate the learning environment using effective technology based pedagogy. TPACK skills are needed by teacher educators because they facilitate effective teaching and learning along with helping prospective teachers to use them efficiently (Lee & Tsai, 2010). Yurdakul (2012), also states that teacher inefficiency in terms of knowledge of various teaching skills as well as inability in technology are the main obstacles to assimilating technologically integrated teaching and learning in the classroom. As stated by (Hew & Brush, 2007), the barriers to technological assimilation consist not only of the absence of certain technologies and teaching skills but also the absence of pedagogical knowledge and technology-supported content.

Based on the description above, it is necessary to develop an TPACK integrated CPS model in improving students' higher order thinking skills.

■ METHODS

Participants

The population of this study is class XI students of SMAN 2 Selong East Lombok which consists of 6 classes. Randomly 1 class was taken with a total of 35 students consisting of 15 male students and 20 female students as research subjects.

Research Design

The type of research used in this research is the development research Borg and Gall (2007), which is a systematic process carried out in developing an educational product and refers to the development of learning designs including needs analysis, design product, development product, implementation and evaluation product. (Dick, Walter, Carey, & Lou, 2001).

The needs analysis was carried out by interviewing 3 mathematics teachers regarding the application of the learning strategies used and providing questionnaires to 35 class XI students of SMAN 2 Selong about students' feelings after participating in mathematics learning. Based on the results of the needs analysis, researchers compile a draft of creative problem solving model integrated TPACK. The draft is then consulted with material experts, linguists and learning technologists to measure the feasibility of the learning design being developed and revised based on input from experts. The next step, a trial was carried out in the classroom for 3 meetings to 35 class XI students of SMAN 2 Selong who were the subjects of the study. The implementation of learning is measured using a questionnaire about student responses to the implementation of learning. Meanwhile, to measure whether the learning design developed has the potential to improve students higher order thinking skill, the t-test is used using One Group Pretest Posttest Design and calculating the N-Gain scores of pretest and postest scores.

Instrument

The instruments used in this study include (1) guidelines for validation of learning products, (2) guidelines for the practicality of implementing learning and (3) essay tests of students' higher-order thinking skills. The learning product validation guidelines developed contain measurement indicators including: (a) goal formulation indicators, (b) content indicators, (c) language indicators, and (d) time indicators. While the product practicality guidelines developed contain indicators of (a) students' feelings of pleasure towards the learning process, (b) assessment of the novelty of products developed in learning, (c) students' interest in following learning using developed products. The high-order thinking test instrument used is an essay test with 5 questions with indicators: 1) determining the problem; 2) explore the problem; 3) plan solutions in solving problems according to the solution strategies that have been selected and drawn up, and 4) implement plans, 5) review solutions, 6) evaluate (Winarti, 2017).

Data Analysis

Products in the form of learning designs that have been developed are validated by 3 experts, namely material experts, learning technology experts, and linguists. The quality of the development product in the form of a CPS model integrated TPACK is measured based on product validity, product practicality and product effectiveness. Product validation indicators are presented in Table 1, Table 2 and Table 3.

Table 1. Product validation guidelines developed by material experts

Aspects	Indicators
Conformity	The order of conformity of the learning design with the model developed with the basic competencies and indicators of competency achievement in the curriculum
Ease	The language used in developing products with a order of understanding is difficult, moderate or easy by the teacher.
Completeness	Completeness of materials and selection of technology
Clarity	Clarity of description and systematic arrangement of the material in the learning model

Table 2. Product validation guidelines by learning technology experts

Aspects	Indicators
Conformity	The developed product integrates technology that matches the learning material taught by the teacher
Ease	Products developed using technology that is easy for teachers and students to use
Communicative	The language used is easy to understand and the selection of technology for learning that is easy for students to use

Table 3. Product validation guidelines by linguists

Aspects	Indicators
Readability	Products developed using good and correct language rules
Ease	Products developed using language that is easy for teachers and students to use
Communicative	The language used is easy for students to understand and understand

Products developed in the form of learning designs with a TPACK integrated creative problem solving model are said to be valid if the product developed is in accordance with each aspect with indicators set for each aspect. The validity criteria of the learning model developed, namely the creative problem solving model integrated TPACK are used criteria Table

Table 4. Learning model validity criteria

Interval Score	Validity Criteria
$x \geq 85$	Very valid
$70 \leq x < 85$	Valid
$45 \leq x < 70$	Quite Valid
$x < 45$	Invalid

The practicality of the product developed in the form of a creative problem solving model integrated TPACK is tested based on (1) an assessment of the practicality of the product by an expert, (2) the magnitude of the teacher's response after carrying out TPACK integrated Creative Problem Solving with criteria such as Table 5.

Table 5. Practicality criteria of learning models

Interval Score	Practicality Criteria
$x \geq 85$	Very Practical
$70 \leq x < 85$	Practical
$45 \leq x < 70$	Quite Practical
$x < 45$	Impractical

Meanwhile, to test the effectiveness of the product developed in the form of a CPS model integrated TPACK was tested using a t test with a significance level of 5% for each indicator of high order thinking skills. Meanwhile, to test the potential effects of products that have been developed in improving students' higher-order thinking skills, it is carried out by calculating the N-Gain score, which is calculating the difference between the postes score and the pretests obtained by students.

RESULTS AND DISCUSSION

Needs analysis

Before conducting research as a basis for product development, researchers conduct a needs analysis by conducting interviews with mathematics teachers regarding the application of learning strategies used and providing questionnaires to students about students' feelings after participating in mathematics learning. The results of interviews with 3 mathematics teachers can be concluded that (1) most of the learning process carried out is still conventional and not student-centered, the teacher's dominance in learning is very high, students' thinking ability has not developed adequately and the teacher provides more examples and practice questions; (2) In learning, teachers have not integrated technology in teaching certain concepts such as utilizing laptops, google classrooms, google drive applications and other applications in accordance with current learning demands; (3) In learning, schools need to prepare supporting facilities related to the use of technology such as laptops, google classrooms and internet networks that are adequate in integrating technology in learning; (4) Teachers expect support from schools to improve their knowledge in the field of technology and information as part of the competencies needed in carrying out current learning.

Meanwhile, based on the questionnaire given to 35 students of class XI of SMAN 2 Selong on the learning carried out by mathematics teachers, it shows that (1) the learning obtained in general has not been fun, boring, and seems that mathematics is still considered one of the difficult and scary lessons with a percentage of 75%; (2) In learning, teachers' efforts to develop students' higher order thinking skills have not been optimal so that students are confused when facing non-routine questions, which require high-order thinking skills in solving the problems faced; (3) In learning, teachers and students have not utilized adequate technology due to the availability of technology needed in learning in schools with a percentage of 80%, this is due to the lack of facilities prepared by the school and the economic ability of parents of students to prepare facilities such as android; (4) In learning, teachers have not used innovative and varied learning strategies so that learning is a momoton with a percentage of 75%. Referring to the needs analysis above, it is necessary to develop a learning model that is able to develop students' higher-order thinking skills by actively involving students in learning so that two-way interaction in learning can be carried out.

Product Design

The product developed is in the form of a learning design for the TPACK integrated Creative Problem Solving model, namely how in teaching certain materials teachers are able to integrate technology with their pedagogical knowledge. TPACK integrated CPS model syntax developed with steps such as Table 6.

Table 6. Syntax of tpack integrated creative problem solving model

No	Fase	Teacher Activities	Student Activities
1	Orientation to the problem	The teacher divides a group of 3-5 students, explains to the	Pay attention to the teacher's explanation of the problem to be solved.

		students about a given problem	
2	Disclosure of opinion	Teachers facilitate students in exploring ideas	Students are freed to express their opinions on a wide variety of problem-solving strategies by digging through their information through the internet and android
3	Evaluation	Teachers guide students in problem solving	Each group discusses which opinions or strategies are suitable for solving the problem
4	Implementation	Teachers facilitate individually and in groups in finding solutions to problems	Students determine strategies that can be suitable for solving problems and finding solutions to problems by accessing the information needed with their android.
5	Presentation	Teachers guide and direct students in presenting and providing reinforcement	Representatives of each group presented the results of the problem solving carried out, while the other group gave responses
6	Reflection	The teacher evaluates all problem-solving activities carried out by students. Together with students draw conclusions to get concepts related to the problem that students solve	Students draw conclusions based on problems solved under the guidance of the teacher

Product Development and Evaluation

The product in the form of a learning design of the TPACK integrated creative problem solving model is validated by three experts, namely learning material experts, learning technology experts, and linguists using validation sheets that have been prepared with the specified validity criteria. The validation results are used to revise the product developed based on expert input and advice. Based on the results of the validity analysis, a product validity score is obtained as presented in Table 7.

Table 7. Validation results of developed products

Component	Validation Results		
	Material Expert	Technologist	Linguist
Identity	92	90	85
Formulation Indicators	81	79	85
Goal Formulation	85	80	82
Material suitability	80	82	80
Preliminary Activities	80	85	85
Core Activities	82	85	84
Learning Activities	85	87	86
Technology Selection	87	86	85
Technology Integration	85	85	82
Concluding Activities	84	87	85
Language Use	82	85	82
Average Score	83,91	84,64	83,73
Conclusion	Valid	Valid	Valid

Based on the validation results by the experts in Table 7 above, the average product validation scores of the three experts are consecutively 83.91; 84,64; and 83.73 so that the product developed is valid and suitable for use.

Product Revisions

Product revision is carried out based on the input of experts. Some of the components that need to be revised include: 1) Aspects of indicator formulation, namely the need to use operational verbs C4, C5, and C6 that measure higher order thinking skills, 2) Aspects of technology selection, it is recommended to use applications that are easy for students to use, 3) Language aspects, it is recommended to use language that is easy for students to understand.

Product Practicality

The learning design of the creative problem solving model integrated TPACK that was developed was tested based on practicality scores by experts and the implementation learning carried out by teachers in teaching integral material using predetermined practicality criteria. Based on the data obtained from the observation sheets that have been collected both observation sheets by experts and teacher responses, presented as Table 8 and Table 9.

Table 8. Results of the practicality assessment of the developed model

Validators	Score	Category
Material Expert	82.25	Practical
Technologist	84.14	Practical
Linguist	80.54	Practical
Average	82.31	Practical

Table 9. Product practicality assessment results during learning

Aspects of Observation	Meeting		
	First	Second	Third
Delivery of learning objectives	84	84	85
Motivating Students	85	85	85

Giving real problems	82	84	82
Material Mastery	83	80	82
Mastery of Technology	80	82	82
Technology Integration	79	80	80
Classroom Management	82	80	85
Conducting Evaluations	80	84	85
Making a Conclusion	82	84	85
Average Score	81.89	82.56	83.44
Average		82.63	
Category	Practical	Practical	Practical

Referring to the scores shown in Table 9 above, it shows that, the application of learning using the TPACK integrated Creative Problem Solving model for 3 meetings shows that the learning model used in learning is included in the practical category both at meetings 1, 2, and 3. However, based on the results of observations at each meeting, there are several things that must be improved in the implementation of learning. At the first meeting, the results of the observations showed that teachers need to make improvements in aspects 1) mastery of the technology used needs to be adjusted to the material taught and it is recommended that teachers socialize first before being used in learning,2) re-examining the order of learning syntax so that the implementation of learning is more systematic and follows the syntax that has been formulated in the learning design, 3) in drawing conclusions, it is recommended that the teacher first ask the students to draw conclusions and the teacher directs not the teacher who directly draws conclusions. In the second meeting, the results of the observations showed that mastery of learning syntax is still not fully mastered by the teacher, this is because the application of TPACK integrated creative problem solving learning tends to be new to teachers and it is recommended that the learning syntax be better understood. In addition, the integration of the technology chosen in exploring concepts also still needs to be improved. At the third meeting, the real problems that the teacher chooses in the initial activity need to be adapted to the material being taught and more challenging which requires various strategies in solving. In addition, teachers need mastery of essential and advanced materials because this will affect the management of the class carried out by the teacher. In drawing conclusions, the teacher also needs to ask the students to draw conclusions and the teacher provides reinforcement.

Product Effectiveness

Pretest and postes score of students higher order thinking skills on integral material were obtained by providing essay tests to 35 students of class XI of SMAN 2 Selong before and after getting creative problem solving model integrated TPACK. The scores of the pretest results and postest of the students higher order thinking skills are shown as in Figure 1.

The effectiveness of the developed product is measured using a t-test against each indicator of students' higher order thinking skills. The t-test with subjects of 35 students for each indicator of higher-order thinking skills with a significance level of 5% is presented as Table 10

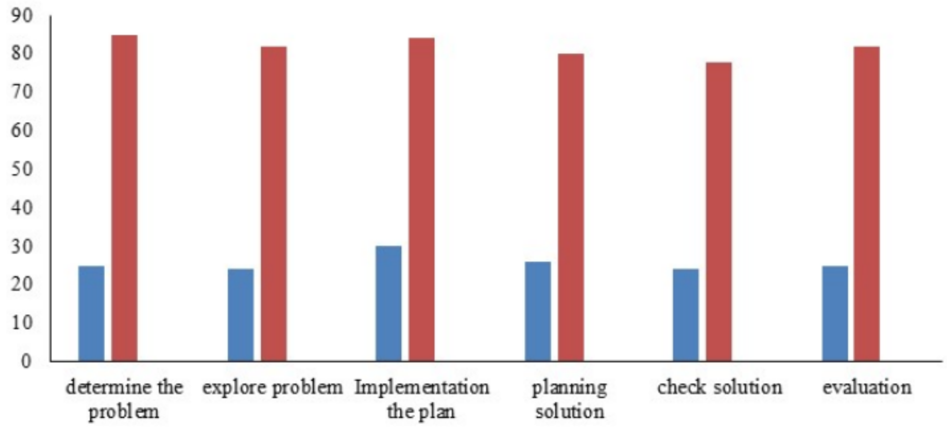

Figure 1. Pretest and postest score showed in blue and red color, respectively

The effectiveness of the developed product is measured using a t-test against each indicator of students' higher order thinking skills. The t-test with subjects of 35 students for each indicator of higher-order thinking skills with a significance level of 5% is presented as Table 10

Tabel 10. Test t indicators of higher order thinking skills

Indicators	Average score of high order thinking skills		t value		Conclusion
	Pretest	Postest	t_{count}	t_{table}	
Determine the problem	25	82	77.97	2.03	effective
Explore problem	24	82	89.12	2.03	effective
Planning solutions	30	84	34.94	2.03	effective
Implementation the plan	26	80	59.79	2.03	effective
Checking solutions	24	78	70.41	2.03	effective
Evaluation	25	82	68.81	2.03	effective
Average score	25.67	91.83	98.54	2.03	effective

Based on Table 10, the t-test for each higher-order thinking skills indicator as well as the test for the indicator as a whole shows that the learning model developed is effective in improving students' higher-order thinking skills.

While the n-gain value for determine problem indicator of 0.80 belongs to the high category, the explore problem indicator of 0.76 belongs to the high category, the planning solution indicator of 0.86 belongs to the high category, implementation the plan indicator of 0.73 in the high category, the checking solution indicator of 0.71 in the high category and the evaluation indicator of 0.76 in the high category. Similarly, if you look at the average score of 6 indicators of high-level thinking skills, the N-Gain value of 0.77 belongs to the high category. Based on the foregoing, it can be said that the application of the creative problem solving learning model integrated TPACK has a high potential in improving the higher-order thinking skills of high school students.

Learning with the creative problem solving model integrated TPACK begins with the provision of real problems by the teacher that students must solve. Furthermore, students are directed to explore information related to problems provided by teachers by utilizing technology such as using androids to get new ideas and ideas used to solve these problems through active discussions both in groups and between groups. Discussions in groups are intended so that students can express ideas and ideas and experiment in solving problems, and then students present the results of solving their problems. A series of activities ranging from giving problems to presenting the results of discovery or problem solving, both teachers and students utilize information technology that is in accordance with each stage of the series of learning activities, for example presenting real problems through videos, the google drive application to send real problems that students must solve and androids that students use to explore various information used to solve these problems. Discussions in groups are intended so that students can express ideas and ideas and experiment in solving problems, and then students present the results of solving their problems. A series of activities ranging from giving problems to presenting the results of discovery or problem solving, both teachers and students utilize information technology that is in accordance with each stage of the series of learning activities, for example presenting real problems through videos, the google drive application to send real problems that students must solve and androids that students use to explore various information used to solve these problems. The series of learning activities carried out like this are believed to be able to foster higher order thinking skills and student curiosity. The learning process that actively involves students in learning by utilizing various appropriate and adequate learning resources is expected to be able to create student curiosity (Kwon, 2014). The application of creative problem solving model integrated TPACK allows students to discuss in groups to develop mathematical problem solving skills. Learning with the creative problem Solving model integrated TPACK provides opportunities for students to explore information, find ideas and find concepts that can be used by students in problem solving (Schmidt, 2009).

The use of appropriate and appropriate technology in learning is very necessary in teaching a certain material. In this case, teachers are required to have the competence to ensure that the selection and use of technology in learning is effective. In addition, teachers are also required to understand when the chosen technology is used and how to use it, anticipate the impact caused by the use of technology in learning and the effectiveness of the technology used in teaching certain teaching materials by using certain learning strategies (Guerrero, 2010). Integration of technology, pedagogy and content in the form of TPACK based learning tools as creative solutions developed in learning (Beri, 2021). TPACK based learning tools optimize student learning activities and are able to improve students' higher-order thinking skills (Archambault, 2010)

The integration of TPACK in teaching certain materials in learning refers to the ability of a teacher to integrate the content of the material to be taught into the form of learning with the teacher's pedagogical abilities that are adequate for various abilities and characteristics of students (Khine, 2017). By integrating TPACK when a teacher applies creative problem solving learning in learning certain teaching materials has high potential in developing and improving students' abilities in solving mathematical problems provided by the teacher. Besides having an impact on improving students problem-solving abilities, the development of an integrated TPACK model using the creative problem solving model is also believed to have an impact on improving students' high order thinking skills, namely critical thinking ability, creative thinking ability and students' mathematical communication skills.

CONCLUSIONS

The product developed in the form of creative problem solving model integrated TPACK design has been developed based on needs analysis and developed systematically and refers to the stages of developing the Borg & Gall learning model. The learning design using the creative problem solving model integrated TPACK developed, based on validity, practicality, and effectiveness tests has met the criteria that have been set. The validation results by 3 experts, each linguist, material expert, and expert in learning technology showed that the product developed was included in the category of valid and worthy of continuing at the field trial stage. Based on the practicality assessment carried out by ahi, products in the form of learning designs using the creative problem solving model integrated TPACK also meet the practicality category. Similarly, after conducting trials in class for 3 meetings, the results of observations showed that the score of the implementation of learning application at meetings 1, 2, and 4 was included in the paktis category. Meanwhile, the product in the form of a learning design using the creative problem solving model integrated TPACK developed is an effective category indicated by the percentage of students who obtained a high-order thinking skills score on integral material and its use e" 75 by 88.57%, higher than the set effectiveness indicator of 85%. The learning model used, namely the creative problem solving model integrated TPACK, also has a high potential effect in improving students high order thinking skills as indicated by an N-Gain score of 0.77

The implications of this research, in today's 21st century learning, teachers are not only spectators of technological developments but teachers are also expected to be actors who are able to use technology in learning. In addition, teachers are also expected to be able to use innovative student-centered learning strategies. Teachers are also expected to be able to develop students' high order thinking skills by applying student-centered learning models, especially the creative problem solving learning model integrated TPACK. I would like to express my deepest gratitude to the Ministry of Education, Research and Technology and LPDP for providing funding so that this research can be completed properly. I would also like to thank the dean of the Faculty of Mathematics and Natural Sciences, Hamzanwadi University for providing facilities and support in completing this research.

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