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## Students Creative Thinking Skills in the Context of Handling Fish Bone Waste with Problem-Based Learning Model

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### ABSTRACT

This study aims to build students' creative thinking skills in the context of handling fish bone waste by using a Problem-Based Learning model. The research method applied was Developmental Research with pre-experimental research design one group pretest-posttest. This research was conducted at one of the MANs located in Medan City. The sample in this study were 32 students of class XI IPA in the even semester of the 2019/2020 school year. Research activities were carried out online with the help of the WhatsApp application and zoom. The research instrument used the form of 12 essay items on the validated student worksheets (LKS) and suitable for measuring students' creative thinking skills. The data obtained from this study were analyzed quantitatively using Microsoft Excel and SPSS software. The results showed that students' creative thinking skills in the context of handling fish bone waste by using a problem-based learning model were included in the "Good" category with an average overall percentage of 63%.

## 1. Introduction

21st century education requires a number of competencies that must be possessed by students, one of which is creative thinking (creative thinking). Creative thinking skills are a thought process that creates new ideas in a wide variety of ways (Hidayat et al., 2018). Creative thinking is a series of cognitive activities used by individuals according to certain objects, problems and conditions based on individual capacities by using imagination, intelligence, insight, and ideas when facing these situations (Birgili, 2015). Students with high creative thinking skills will like to ask questions and be motivated to seek new experiences and discoveries that satisfy them (Murtiningrum et al., 2013).

In the 2013 curriculum, the focus of the learning process is activity and creativity, inspiring, fun, student-centered, authentic, contextual and meaningful, appropriate

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learning models include Problem-Based Learning (Fadliah et al., 2018). By using a problem-solving model, it trains students to connect the concepts they have with real life, but also requires students to be able to develop their thinking skills in solving the problems they face (Arisanti et al., 2016). In the problem-based learning model, the focus of learning is on the selected problem so that students not only learn concepts related to problems but also scientific methods to solve these problems (Ngalimun, 2013). According to Tan (2003) the objectives of problem-based learning are learning content, obtaining lessons related to analytical procedures, developing problem mechanic skills, and lifelong learning goals such as independent learning, skilled information processing, collaborative and group learning, as well as reflective and evaluative thinking skills. Problem-based learning has many advantages in its application, but it is still not maximally implemented because of several obstacles, namely students who already feel that the problems being studied are difficult to solve, lack of teaching aids, and inadequate laboratory equipment, and require a long time to implement (Friani et al., 2017; Tyas, 2017; Aidoo et al., 2016; Warsono, & Hariyanto, 2013).

Several previous studies that have been conducted using a problem-based learning model have shown good results, which can improve creative thinking skills, cognitive abilities, conceptual mastery, critical thinking, and student academic achievement (Ulger, & Imer, 2013; Birgili, 2015; Fahrurroji. et al., 2016; Efwinda & Sopandi, 2016; Wahyu et al., 2018). The problem-based learning model exposes students to a problem that exists in everyday life so that students can compile their own knowledge to solve existing problems by looking for various solutions so as to encourage students' creative thinking skills (Purnamaningrum et al., 2012). From this explanation, it can be seen that there is a fairly close relationship between problem solving and creative thinking skills where creative thinking skills are the process of bringing up a new idea by combining existing ideas. Meanwhile, problem-based learning is learning that stimulates students to think at higher levels in problem-oriented situations (Utomo et al., 2014).

The problems caused by waste are of course a concern to continue to minimize their negative impacts, one of which is by processing waste into a useful product. Fish waste is one example of waste that is commonly found in Indonesia. The waste that can be generated from the total body weight of fish is around 37.9% consisting of 10-12% head; 11.7% bone; 3,4% fins; 4% skin; 2% spines; and 4.8% stomach contents. These parts actually still have high economic value, one of which is bone (Tazwir et al., 2007). One of the processing of fish bone waste can be used to become gelatin due to the collagen content in the bones. A lot of research has been done on the utilization of waste from various fish bones into gelatin, which has been done a lot, including the manufacture of gelatin from tilapia fish bones, mondoled stingrays, red stingrays, mackerel fish bones, skipjack bones, tuna fish bones, and fish bones. belida (Wijaya et al., 2015; Santoso et al., 2015; Adiningsih, & Purwanti, 2015; Hidayat et al., 2016; Ridhay et al., 2016; Panjaitan, 2016; Mahmuda et al., 2018).

The utilization of fish bones into gelatin is one example of the application of colloid materials. However, so far no one has conducted research on the scope of

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handling fishbone waste at the high school level. So that researchers are interested in conducting research that aims to build students' creative thinking skills in the context of handling fish bone waste by using a problem-based learning model.

## 2. Methodology

This research used the developmental research method with the stages of design, develop, and evaluation (Richey, 2007). Data sampling was carried out by using purposive sampling technique with a total sample size of 32 people from class XI IPA even semester of the 2019/2020 academic year in one of the MANs in Medan City. Research activities were carried out online (learning from home) with the help of the WhatsApp application and zoom. The research instrument in the form of essay questions as many as 12 items contained in the LKS (Student Work Sheet). The instrument used has gone through the validation stage to measure students' creative thinking skills. The instrument was given during the learning process using a problem-based learning model with stages (1) identifying problems, (2) analyzing and formulating problems, (3) designing problem solutions, (4) presenting evaluation of the solutions taken, (5) evaluation (Tan, 2003). Indicators of creative thinking skills that are seen are fluency, flexible thinking, originality, elaboration, and evaluative thinking. The data obtained were then analyzed quantitatively using Microsoft Excel and SPSS software.

The score on each indicator of creative thinking skills obtained by students from each item is different. The calculation of the final value of creative thinking skills obtained by students uses the following formula.

Final score = (total score obtained) / (maximum number of scores) x100

The categories of creative thinking skills obtained by students are shown in Table 1 Arikunto (2009).

Table 1. Scale Category Score Analysis Results

Score Range (%)	Category
81 – 100	Very well
61 – 80	Good
41 – 60	Enough
21 – 40	Less
<21	Very Less

## 3. Results and Discussion

Students' creative thinking skills measured during the learning process are fluency, flexibility thinking, originality, evaluation thinking, and elaboration thinking (Munandar, 2014). Learning activities are designed to support students in constructing their abilities through discussion, question and answer, problem solving and presentations made in the form of PowerPoint. Because creative thinking skills can arise from a habit that comes from the mind that is trained by

showing intuition, turning on the imagination, bringing up new possibilities, opening a different point of view and unexpected ideas (Iskandar, 2009). Creative thinking requires persistence, discipline, and focus which is a mental activity, namely asking questions, thinking about new information and unusual ideas, building relationships between things that have differences, connecting different things and listening to intuition (Johnson, 2007).

Learning in the context of handling fishbone waste using a problem-based learning model is carried out online (learning from home) with the help of the WhatsApp application and zoom as a means of interacting in the form of discussions, questions and answers, problem solving, and presentation of discussion results due to the implementation of the learning that is being carried out. amid the conditions of the Covid-19 pandemic. Students are grouped into 5 study groups based on those based on abilities that are considered high, medium, and low. The division of groups can be seen in Figure 1.

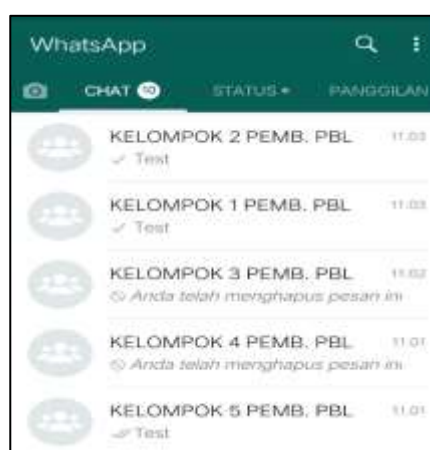


Figure 1. Whatsapp Groups 1-5 Groups

### **Learning with a Problem-Based Learning Model**

Learning with a problem-based learning model on handling fish bone waste consists of 3 meetings where each meeting students will be given a worksheet as material for discussion with their group friends. LKS can help students improve creative thinking skills and make it easier for students to understand the concepts that are being studied (Abdurrozak et al., 2016). At the first meeting, PBL learning was carried out in stage 1, namely identifying problems. Students are directed to find key information contained in the articles in the worksheets then make 3 questions based on what they want to know, then continue by giving video shows about the conditions of fish waste processing (fish bones) that are not yet optimal. At this stage, it aims to guide students in determining the problem to be solved related to the issue given, namely the handling of fish bone waste. This stage teaches that information does not only come from the teacher, but can come from various sources (Desriyanti, & Lazulva, 2016). Aspects of

creative thinking that are seen at this stage are fluency and flexibility. At this stage the highest final score was obtained by group 5, namely 88.9 in the "Very Good" category. The answers of group 5 students can be seen in Figure 2.

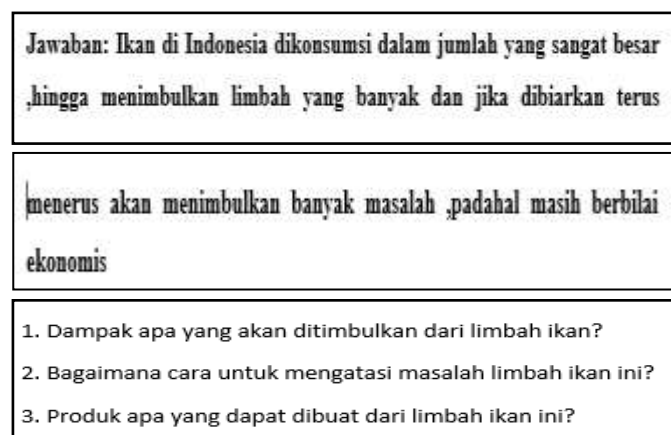


Figure 2. Answers to Group 5 at the PBL Stage of Identifying Problems

Furthermore, PBL stage 2 is analyzing and formulating problems. His group sought more information about fish bones, namely the type of waste produced and the content of fish bones. Students also discussed the negative impacts that fishbone waste could have on the environment. Furthermore, in the final stages of discussion, students are guided to formulate problems that will be resolved with the group so that appropriate and appropriate problem formulations are formed (Agustin et al., 2018). Aspects of creative thinking that are seen are fluency, flexible thinking. At this stage the highest final score was obtained by group 3, namely 82.6 in the "Very Good" category. The answers of group 3 students can be seen in Figure 3.

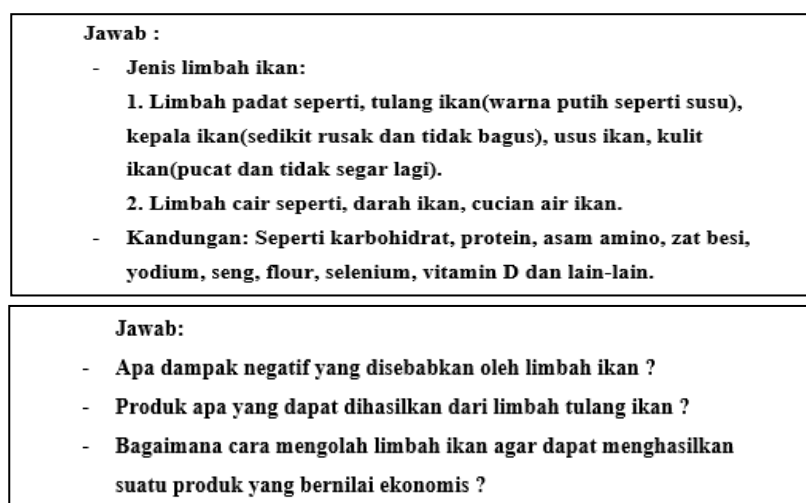


Figure 3. Answers to Group 3 at the PBL Stage of Analyzing and Formulating Problems

At the second meeting the core activities in problem-based learning were stage 3

designing problem solutions. Students are guided to find alternative solutions to problems that have been found in previous meetings, namely products that can be produced from fish bone waste, design experiments together with their group of friends and look for alternative materials that can be used as substitutes if the materials that are supposed to be used are not available. Aspects of creative thinking that are seen are original thinking (originality) and elaborative thinking (elaboration). At this stage the highest score was obtained by group 5, namely 65.3 in the "Good" category. The answers of group 5 students can be seen in Figure 4.1, Figure 4.2, and Figure 4.3.

1. Dengan mengolah atau memanfaatkan kembali limbah ikan tersebut menjadi produk yang lebih berguna yang bisa meningkatkan nilai ekonomis yang tinggi .
2. Seperti tepung ikan, gelatin, minyak ikan, kecap ikan, pupuk, terasi, dan sebagainya.

Figure 4.1. Products from Fish Bone Waste

Pembuatan gelatin dari limbah tulang ikan
Tujuannya agar kita mengetahui pemanfaatan limbah tulang ikan menjadi produk yang memiliki nilai ekonomis yang tinggi.
<ol style="list-style-type: none"> <li>1. Siapkan bahan-bahannya seperti tulang ikan tenggiri, air bersih biasa, air aquades, larutan asam.</li> <li>2. Siapkan alat-alatnya seperti baskom, pisau, telenan, saringan, oven, kertas PH, dan kertas whatman.</li> <li>3. Lalu, Rebus tulang ikan dengan suhu 70°C selama 30menit , kemudian cuci bersih tulang ikan tersebut.</li> <li>4. Setelah dicuci potong-potong kecil ± 2cm dan siap kan larutan aquades dan asam HCL sesuai kebutuhan.</li> </ol>
<ol style="list-style-type: none"> <li>5. Kemudian, rendam tulang ikan dengan aquades dan asam Hcl(Proses Hidrolis Dengan Asam)selama 3 hari hingga lembut dan setelah lembut kemudian saring dan bersihkan dri lemak.</li> <li>6. Lalu bersihkan dengan air mengalir dan tiriskan tulang tersebut.</li> <li>7. Kemudian tulang diekstraksidng aquades selama 7jam lalu saring.</li> <li>8. Lalu di filtrat lalu dikeringkan dengan menggunakan oven.</li> <li>9. Setelah semua selesai gelatin tersebut di haluskan.</li> </ol>

Figure 4.2. Experimental Design for Making Gelatin

Jika larutan Hcl tersebut tidak ada di laboratorium kita ,kita bisa menggantinya dengan larutan asam lain seperti :Asam sulfat( $H^2SO^4$  ),Asam posfat( $H^3PO^4$  ),

Figure 4.3. Acid Replacement Alternatives

At the last meeting the core activity of learning with a problem-based learning model was stage 4, namely the presentation of evaluation of solutions, at this stage students were guided to make reports of the discussions that had been

carried out into PowerPoint. The aspect of creative thinking that is seen is fluency. The highest score was obtained by group 4, namely 85.7 in the "Very Good" category. The powerpoint assessment is carried out based on the content, design, slide sequence, and font size used. Furthermore, stage 5 evaluation. At this stage students are required to determine what concepts are used in making the product, as well as the conclusions to be drawn. Aspects of creative thinking that are seen are evaluative thinking (evaluation), fluency thinking. At this stage the highest score was obtained by group 4 with a percentage of 83.3 in the "Very Good" category. The answers of students in group 4 can be seen in Figures 5.1 and 5.2.

**Jawaban:** saya bisa menyimpulkan bahwa limbah ikan tidak hanya didapat dari pabrik atau pasar saja, namun restoran juga. Kita tahu limbah ikan berasal dari kebutuhan manusia juga, seperti untuk mengkonsumsi ikan diperlukan membersihkan ikan terlebih dahulu sehingga adanya limbah ikan tersebut yaitu tulang, kulit, sisik, dll. Kita sendiri tahu limbah ikan ini memberikan dampak kepada kehidupan kita baik positif maupun negatif. Limbah ikan bisa memberikan dampak positif dan dapat dimanfaatkan jika kita kreatif dan tahu apa yang harus dilakukan dengan adanya limbah tersebut, misal dijadikan bahan membuat pelet, dijadikan pupuk atau yang lebih umum di masyarakat

Figure 5.1. Chemical Concepts in Product Manufacturing

**Jawaban:** saya bisa menyimpulkan bahwa limbah ikan tidak hanya didapat dari pabrik atau pasar saja, namun restoran juga. Kita tahu limbah ikan berasal dari kebutuhan manusia juga, seperti untuk mengkonsumsi ikan diperlukan membersihkan ikan terlebih dahulu sehingga adanya limbah ikan tersebut yaitu tulang, kulit, sisik, dll. Kita sendiri tahu limbah ikan ini memberikan dampak kepada kehidupan kita baik positif maupun negatif. Limbah ikan bisa memberikan dampak positif dan dapat dimanfaatkan jika kita kreatif dan tahu apa yang harus dilakukan dengan adanya limbah tersebut, misal dijadikan bahan membuat pelet, dijadikan pupuk atau yang lebih umum di masyarakat

adalah dapat diolah menjadi gelatin yang bisa menjadi nilai ekonomis yang dapat membantu kehidupan ekonomi. Dalam pengolahan limbah tulang ikan juga dibutuhkan proses pemberdayaan masyarakat secara intensif. Pemberdayaan masyarakat dalam pemanfaatan limbah tulang ikan ini mencakup masyarakat luas. Proses pemberdayaan masyarakat dalam pengolahan tulang ikan diupayakan untuk mencapai kemandirian masyarakat dalam penanganan limbah pasca pengolahan ikan pada situasi dan kondisi yang antagonis.

Salah satu pengolahan kreatif limbah tulang ikan yaitu dengan dibuat menjadi bahan pembuat gelatin. Produksi gelatin dapat memberi peluang usaha kepada masyarakat dengan pemanfaatan limbah tulang ikan untuk produksi hidroksiapatit akan dapat mengatasi permasalahan secara menyeluruh, diantara-Nya masalah lingkungan dan sosial ekonomi, serta menghasilkan produk bersih. Dengan demikian, limbah tulang ikan tidak akan menjadi masalah tetapi justru akan menambah peluang usaha baru. Oleh karena itu, saya pikir limbah ikan ini bisa memberikan dampak positif jika kita paham bagaimana mengolah limbah ini dengan baik, atau setidaknya jangan lakukan hal yang merugikan orang lain dengan membuang limbah di tempat yang tidak seharusnya. Membuang limbah di sembarang tempat dapat menurunkan estetika alam atau bahkan dapat merusak alam.

Figure 5.2. Conclusions from Learning

The overall score obtained by each group at each stage of learning with a problem-based learning model can be seen in Table 2:

Table 2. Scores of Each Group on Problem-Based Learning

PBL stages	CBC indicators	Score Max	Group				
			1	2	3	4	5
Stage 1	Current	3	1	2	2	2	2
	Flexible	3	2	2	2	2	3
	Flexible	3	1	2	3	2	3
	Total	9	4	6	7	6	8
<b>Final score</b>		<b>100</b>	<b>44,4</b>	<b>66,7</b>	<b>77,8</b>	<b>66,7</b>	<b>88,9</b>
Stage 2	Current	21	14	11	17	14	15
	Flexible	2	1	2	2	1	2
	Total	23	15	13	19	15	17
	<b>Final score</b>	<b>100</b>	<b>65,2</b>	<b>56,5</b>	<b>82,6</b>	<b>65,2</b>	<b>73,9</b>
Stage 3	Orisinil	8	2	4	3	3	5
	Elaboratif	29	19	17	16	16	18
	Elaboratif	4	2	3	2	2	2
	Elaboratif	8	7	1	6	6	7
	Total	49	30	25	27	27	32
<b>Final score</b>		<b>100</b>	<b>61,2</b>	<b>51</b>	<b>55,1</b>	<b>55,1</b>	<b>65,3</b>
Stage 4	Lancar	7	5	5	5	6	5
	<b>Final score</b>	<b>100</b>	<b>71,4</b>	<b>71,4</b>	<b>71,4</b>	<b>85,7</b>	<b>71,4</b>
Stage 5	Evaluatif	3	3	2	2	2	3
	Current	9	7	3	3	8	2
	Total	12	10	5	5	10	5
<b>Final score</b>		<b>100</b>	<b>83,3</b>	<b>41,7</b>	<b>41,7</b>	<b>83,3</b>	<b>41,7</b>

Graph of the percentage of each stage of PBL of students from 5 groups can be seen in Figure 6.

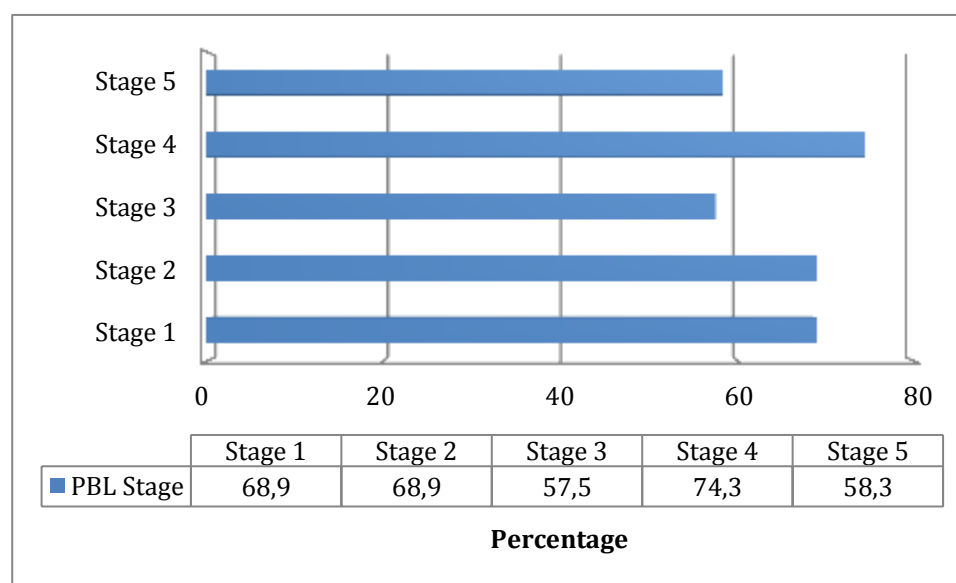


Figure 6. Percentage of PBL from 5 Groups



### Students' Creative Thinking Skills in Handling Fish Bone Waste

The total score of creative thinking skills in the context of handling fishbone waste using a problem-based learning model was 100. The highest score was obtained by group 5 students with a final score of 77.8 which was included in the "Good" category. Overall, the average creative thinking skills of students was 64.7 which was included in the "Good" category. Based on the results obtained, it is known that evaluative thinking skills have the highest average final score of 80.2 in the "Very Good" category. Based on the results obtained, it turns out that the problem-based learning model in the context of handling fishbone waste can build creative thinking skills even though with various limitations such as discussions that are only carried out through whatsapp and zoom groups, the internet network is not good so it is quite difficult to ensure active students. participate in group discussions. The results of this study are relevant to the results of previous studies where PBL can increase student creativity (Wahyu et al., 2018).

Creative thinking skills in each group can be seen in the data from the research results of students' creative thinking skills in each indicator Table 3:

Table 3. Creative Thinking Skills for Each Group

CBC indicators	CBC Sub Indicator	No. Question	Value Max	Final Group Grades					Average Value
				1	2	3	4	5	
Current	Fluent in expressing ideas	1							
	Have a lot of ideas about a problem	4							
	Come up with lots of ideas, answers, problem solving or answers	10	100	68	53	68	75	60	64,8
	Carefully see the strengths and weaknesses of a thing	12							
Flexible	Can see the problem from a different point of view	2							
	Generates a variety of questions	3	100	50	75	88	63	100	75,2
	Thinking of various ways to solve the problem	5							
Orisinil	Think of unusual ways of solving problems	6	100	25	50	38	38	63	42,8
Elaboratif	Doing problem solving in more detail and depth	7							
	Able to enrich and develop an idea	8	100	68	51	59	59	66	60,6
	Looking for a deeper meaning of the steps taken	9							

Evaluatif	Have rational reasons that can explain the results obtained from the experimental design	11	100	100	67	67	67	100	80,2
Average			62,2	59,2	64	60,4	77,8	64,7	

The graphic of students' creative thinking skills can be seen in Figure 7.

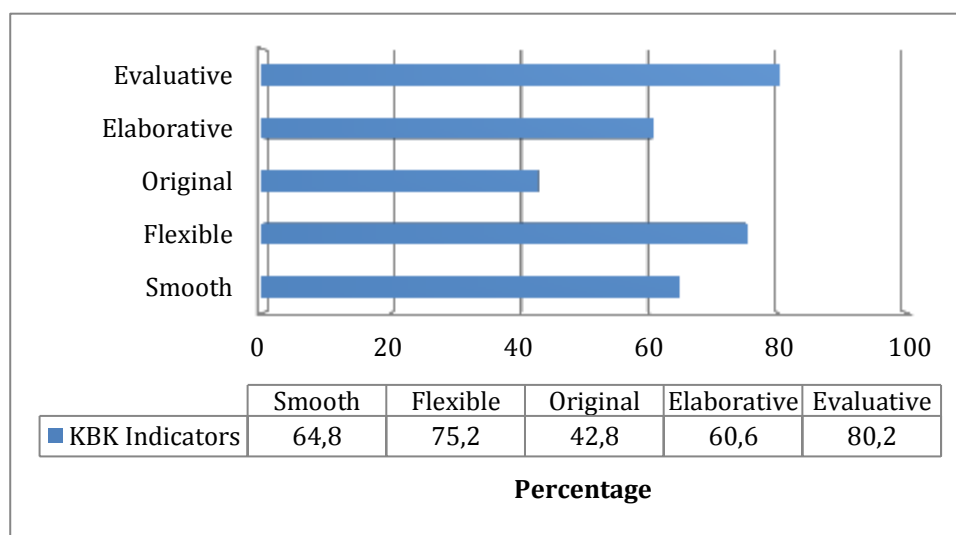


Figure 7. Percentage of Students' Creative Thinking Skills Indicators

Based on the graph above, the percentage of fluent thinking skills is 65% in the "Good" category, 75% of flexible thinking skills are in the "Good" category, 43% of original thinking skills are in the "Enough" category, 60% of elaborative thinking skills are in the "Good" category. ", 80% of evaluative thinking skills are in the " Very Good "category. The research results obtained are reinforced by the results of previous research where the application of the PBL model can improve students' ability to give ideas, and analyze the problems given to the LKS very well (Herdiawan et al., 2019).

#### 4. Conclusion

Based on the results of data analysis and discussion, it can be concluded that problem-based learning can build creative thinking skills in either category. Learning with a problem-based learning model can be used both directly in class and online (learning from home) amid the conditions of the Covid-19 pandemic.

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