ISSN 2715-7458
E-ISSN 2715-7466

Journal of Mathematical Pedagogy
Volume 5, No. 2, July 2024, pp. 54-66

Student Creativity in Creating Geogebra Applet for Quadratic Function Material

Syarifatul Karomah[1], Tatag Yuli Eko Siswono[2], Hutkemri Zulnaidi[3]

[1,2] Universitas Negeri Surabaya, Kampus Ketintang Surabaya 60231, Indonesia
[3] University of Malaya, 50603 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia

Email: syarifatulkaromah.20005@mhs.unesa.ac.id

Abstract

This research aims to describe the creativity and creative process of students with high, medium, and low levels of creativity. This qualitative research involved 6 Senior High School students in grade XI, 2 students at each level of creativity. The data collection technique uses assignments to make Geogebra applets that are analyzed with document analysis methods and interviews related to students' creative processes that are analyzed with interactive models. The research results show that the Geogebra applets produced by students are different at each level. The higher the level, the Geogebra applets are the more complex in use of Geogebra tools, providing many elements of novelty from the examples given, relevant to the task, and effective in achieving the set goals. Furthermore, the student's creative process with the stages of synthesizing ideas, generating ideas, planning the ideas, and applying ideas at each level has a different process. High creativity students go through each creative process stage well and repeat several stages to produce the Geogebra applet as in the assignment. Meanwhile, students with medium and low creativity are not good at going through each stage of the creative process.

Keywords: creativity, creative process, geogebra applet, quadratic function

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan kreativitas dan proses kreatif siswa dengan tingkat kreativitas tinggi, sedang, dan rendah. Penelitian kualitatif ini melibatkan 6 siswa kelas XI dengan 2 siswa pada masing-masing tingkat kreativitas tinggi, sedang, dan rendah. Teknik pengambilan data menggunakan tugas membuat applet Geogebra yang dianalisis menggunakan metode analisis dokumen dan wawancara terkait proses kreatif siswa dalam membuat applet Geogebra yang dianalisis menggunakan model interaktif Miles dan Huberman. Hasil penelitian menunjukkan bahwa hasil produk applet Geogebra yang dihasilkan siswa berbeda-beda pada setiap tingkatan. Semakin tinggi tingkatnnya, applet Geogebra yang dihasilkan siswa semakin kompleks dalam penggunaan tools dalam applet Geogebra, banyak memberikan unsur kebaruan dari contoh yang diberikan, sesuai dengan tugas, dan efektif dalam mencapai tujuan yang ditetapkan. Selanjutnya, proses kreatif siswa dengan tahap mensintesis ide, membangun ide, merencanakan penerapan ide, dan menerapkan ide pada tiap tingkatannya memiliki proses yang berbeda. Siswa dengan kreativitas tinggi melalui setiap tahapan proses kreatif dengan baik dan melakukan pengulangan pada beberapa tahapan untuk menghasilkan applet Geogebra seperti pada tugas. Sedangkan siswa dengan kreativitas sedang dan rendah kurang baik dalam melalui setiap tahapan proses kreatif.

Kata kunci: kreativitas, proses kreatif, applet geogebra, fungsi kuadrat

How to Cite: Karomah, S. Siswono, T.Y.E. & Zulnaidi, H. (2024). Student Creativity in Creating Geogebra Applet for Quadratic Function Material. *Journal of Mathematical Pedagogy, 5* (2), 54-66.

Introduction

Creativity is an important ability for students in the 21st century (Fadlilah et al, 2021). This is in accordance with the 2022 Independent Curriculum which states that students' ability to think creatively is needed to survive in an ever-changing, uncertain, and competitive situation (Kemendikbudristek, 2022). Especially in the 21st century, which is full of innovation, new challenges, and global competition, students need to have 6C skills (Critical Thinking, Communication, Collaborative, Creativity, culture, and connectivity) one of which is creativity (Anugerahwati, 2019; Djam'an, Bernard

& Sahid, 2021). This further shows that creativity is important for students to have. Creativity is important for students to be able to overcome various obstacles and find solutions to problems faced in daily life.

The reality shows that students in Indonesia still have a low level of creativity (Apriansyah and Ramdani, 2018;Rasnawati et al, 2019). Many factors cause low creativity in students. Based on the results of observations, it was found that the tasks given by teachers to students are currently still lacking in facilitating students to think creatively. This is reinforced by research that states that teachers in the classroom tend to only measure low thinking skills, teachers rarely give tasks that can measure high-level thinking skills such as creative thinking (Agustini & Fajriyah, 2017). In addition, classroom learning tends to focus on mastering the material and less emphasis on developing higher-level thinking such as student creativity (Astriani, 2020; Sumarni & Kadarwati, 2020; Partono *et al.*, 2021). Mariani et al (2021) also mentioned that teachers rarely get used to high-level thinking skills in giving questions on tests (Mariani, Ansori and Mawaddah, 2021).

Creativity can be developed through the assignment of appropriate math assignments that can facilitate students to pour out their creative ideas. Buyung (2021) mentioned that to train students' mathematical creative thinking skills, it is necessary to provide questions that can support such as giving rise to a variety of possible answers and solving strategies. The question can be given through the task of making a creative product that will facilitate students in conducting experiments and processing their ideas and creativity. In line with the opinion of Fasko (2001) which states that teachers need to give students time to process, discuss, and conduct experiments to develop creativity. This is also an effort by teachers to create a supportive environment for students because one of the factors supporting creativity is the environment (Puspitasari & Wibowo, 2022). A supportive environment means the opportunities and facilities provided to students to develop their creativity.

One of the assignment platforms that can facilitate students to experiment and create ideas is Geogebra. Hohenwarter dan Fuchs (2004) explained that Geogebra is very beneficial in mathematics learning in high school. Geogebra can help with the demonstration and visualization of mathematical concepts, become a construction aid, assist in mathematical discoveries, and prepare mathematics teaching materials (Hohenwarter & Fuchs, 2004).

The Geogebra applet is an interactive web page that can be run directly without being downloaded from the Geogebra web (Wibowo, 2022). The Geogebra applet can be used for geometry, algebra, statistics, and calculus materials. Geogebra is widely used for geometric materials to provide a clear picture. In addition to geometry, algebra also needs the help of Geogebra to make it easier for students to understand materials and concepts.

Algebra is difficult material for students because not easy to understand the concepts. The advantages of Geogebra that are interactive and can provide feedback quickly allowing users to explore, check and revise the failure in the test until finding the best. Geogebra can make the users build their knowledge and find concepts in algebra material on their own and more meaningful.

One of the concepts in algebra material that is easier to understand through Geogebra is quadratic function material. The concept of explaining the relationship between coefficients and quadratic function graphs will be easier to understand using Geogebra which can provide a clear visualization of the graph. In addition, Geogebra is interactive so that it allows students to explore for understand the concept.

Making Geogebra applets for algebra material, in addition to making understand concepts easier, is also a facility and support for students to pour out their creative ideas to produce creativity. Creativity is a product of the creative process. There are several expert opinions on the stages of the creative process. According to Wallas, there are four stages of the creative process, preparation, incubation, illumination, and verification (Wallas, 1926). The stages of the creative process according to Krulik and Rudnick are synthesizing ideas, generating ideas, and applying ideas. This research uses the stages of

the creative process according to Siswono to be applied in mathematics learning which includes synthesizing ideas, building an idea, planning the ideas and applying the idea to produce something new (Siswono, 2008). The creative process that each person goes through will be different because it is caused by various factors, both within the individual and external factors.

This study aims to analyze the creativity and creative process of students in making Geogebra applets on quadratic function materials. The creation of assignments to make Geogebra applets is expected to be a form of support and facility for students to develop their creativity. In addition, by analyzing students' creativity and creative process in making Geogebra applets, it can be an evaluation and reference material for teachers in carrying out the next learning that pays more attention to students' creativity.

Creativity in making Geogebra applets is the ability of students to create something new in making Geogebra applets. Creativity in making Geogebra applets is the implementation of creativity as a product. Munandar defines creativity as a product related to the ability to create something new or combinations that have not existed before (Munandar, 1998). According to Cropley, to assess students' creativity in making Geogebra applets is seen from three aspects, namely novelty, relevant, and effective (Cropley & Urban, 2000).

Table 1. Rubric on the assessment of creativity in making Geogebra applets

Component	Description	Score
Novelty	Students can make different Geogebra applets from the examples given (NOV3)	3
	Students can make a different Geogebra applet from the example given, but only in certain parts (NOV2)	2
	Students can't make a different Geogebra applet from the example given (NOV1)	1
Relevant	Students be able to make Geogebra applets that are relevant to the assignment (REL3)	3
	Students are less able to make Geogebra applets that are relevant to the assignment (REL2)	2
	Students are unable to make Geogebra applets that are relevant to the assignment (REL1)	1
Effective	The Geogebra applets made by students can well achieve the goals that have been set (EFF3)	3
	The Geogebra applet made by students is not good at achieving the goals that have been set (EFF2)	2
	The Geogebra applet made by the student cannot achieving the goals that have been set (EFF1)	1

The level of creativity of students in making Geogebra applets is grouped as follows.

Table 2. Categories Creativity

Interval	Categories Creativity
$score \geq 7$	High
$5 \leq score < 7$	Medium
$score < 5$	Low

Creativity is the result of the creative process. According to Siswono (2008:61), The creative thinking process is the steps of creative thinking which include synthesizing ideas, generating ideas, planning the ideas, and applying the ideas to produce a new product. The following are indicators of the assessment of the student's creative process in making the Geogebra applet.

Table 3. Indicators of students' creative process in making Geogebra Applets

Stages	Indicators
Synthesizing Ideas	1. students identify commands in assigned assignments (SI1) 2. students understand and explain the information obtained and understand the given assignment sheet and the information they have related to the commands in the assignment (SI2) 3. students relate the information obtained to what is requested in the assignment (SI3)
Generating Ideas	1. students can generate ideas and strategies to complete tasks and ideas related to the use of features or tools in Geogebra (GI1) 2. students can explain where the idea came from (GI2)
Planning the Ideas	1. students can choose the appropriate idea which will be applied in making the Geogebra applet (PI1) 2. students can explain a plan to apply the idea they chose in making the Geogebra applet (PI2)
Applying Ideas	1. students have successfully implemented the selected ideas in making the Geogebra applet (AI1) 2. students check whether the Geogebra applet that has been created is following the assigned assignment (AI2)

Method

This research is qualitative research using the type of case study research. Merriam dalam Siswono (2019:172) said a case study is a type of research aimed at gaining a better understanding of a situation and giving meaning to what is involved in it. This qualitative assessment is used to obtain complete and in-depth data so that it can find out the creativity and creative process of students in making Geogebra applets. The research subject was selected according to the research objectives using the purposive sampling technique. The subject in this study is one class of high school students in grade XI even semester of the 2023/2024 school year which was selected based on the teacher's recommendation with the criteria of having good mathematical skills and the use of technology. Subjects will be given the task of making Geogebra applets then from the results of the task, subjects will be grouped into several levels of creativity, namely high, medium, and low. Then two subjects will be selected in each level to be interviewed. The subjects to be interviewed are students with good communication skills based on recommendations from Mathematics teachers. The researcher, as the main instrument, collects data directly through assignments and interviews. The task given is in the form of an assignment to make a Geogebra applet. The data of the assignment results were analyzed based on the novelty, relevant, and effective components using document analysis techniques. Meanwhile, the data from the interview results were analyzed based on creative process indicators using an interactive model.

Result and Discussion

In the research, it was found that 14 students had high creativity, 12 students had medium creativity, and 8 students had low creativity. Based on the grouping of the results of the assignment score of making the Geogebra applet and the suggestions of the Mathematics teacher, 6 students with high, medium, and low creativity were selected 2 each to be interviewed. The results of the students' Geogebra applet and the results of the interview will then be analyzed based on the creativity component and creative process

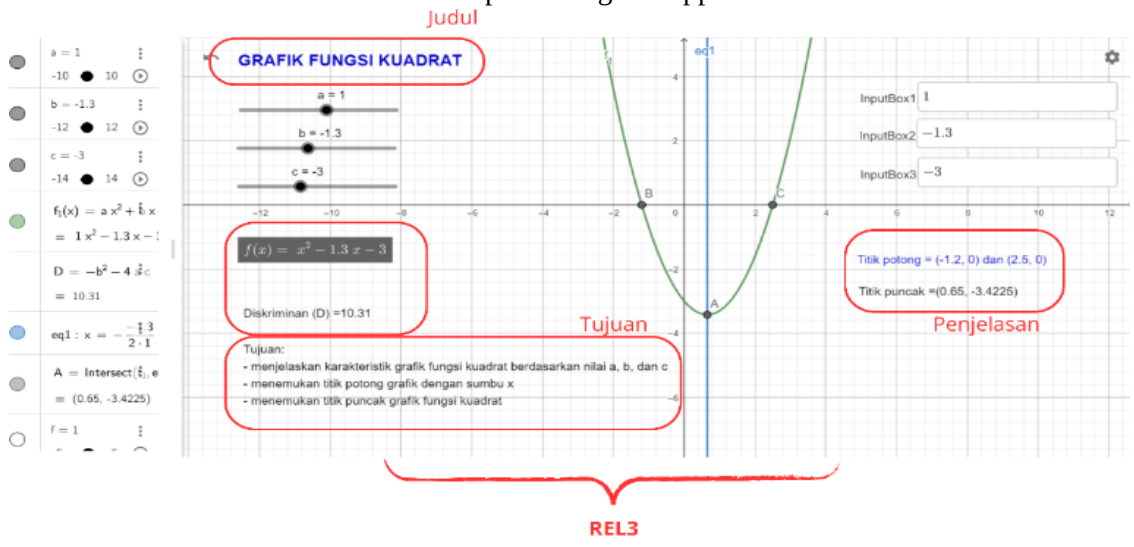
indicators. Based on the results of the score of the task of making the Geogebra applet, the research subjects to be interviewed are as follows.

Table 4. Research Subjects

No.	Categories Creativity	Name	Task Score
1.	High	SAT	9
2.	High	ZZTA	9
3.	Medium	SNI	6
4.	Medium	AS	6
5.	Low	MRRA	3
6.	Low	AC	3

The results of the Geogebra applet of the subject with high creativity are presented in Figure 1. Based on the component of creativity, the subject with high creativity 1 (HC1) managed to achieve the aspect of novelty by creating a Geogebra applet that was different from the given example of the Geogebra applet. The Geogebra applet created by HC1 not only shows the characteristics of the quadratic function graph based on the value a (coefficient x^2) as in the example, but also based on the value of b (coefficient x), and the value of c (constant). In addition, HC1 added the purpose of the Geogebra applet to find the intersection point of the graph of the quadratic function by the x-axis and to find the vertex point of the quadratic function. The subject with high creativity 2 (HC2) makes a Geogebra applet about determining the cut-off point of the graph of the square function with the x-axis. HC2 also explains the manual steps in finding the cut-off point of the graph with the x-axis. HC2 also includes an illustration of the cut-off point so that it is easier to see the position of the cut-off point of the graph of the quadratic function with the x-axis. HC1 and HC2 succeeded in achieving the relevant aspect because it is different from the example, it included the purpose, title, and explanation related to the Geogebra applet that was made. HC1 and HC2 also succeeded in achieving the effective aspect by making Geogebra applets that can achieve the goals that have been set well.

Based on the indicators of the creative process, in the stage of synthesizing the idea of a subject with high creativity (HC), start by reading the task sheet carefully and repeatedly until they can understand the content of the given task well. Therefore, HC can accurately find the information in the task, including the commands in the task. HC is also able to relate well the information obtained to what is requested in the task. In the ideation phase, subjects with high creativity (HC) carry out the collection of information from sources outside the task such as books and the internet to come up with ideas. In generating ideas, HC still pays attention to the information obtained from the task and also what is requested in the task so that the ideas generated can be following the task. In the stage of planning the ideas, subjects with high creativity (HC) can determine or choose the right ideas to fulfill the assigned tasks. HC chooses ideas because they are the best and follow the assignment request. HC can also explain the plan that will be carried out to make a complete Geogebra applet.



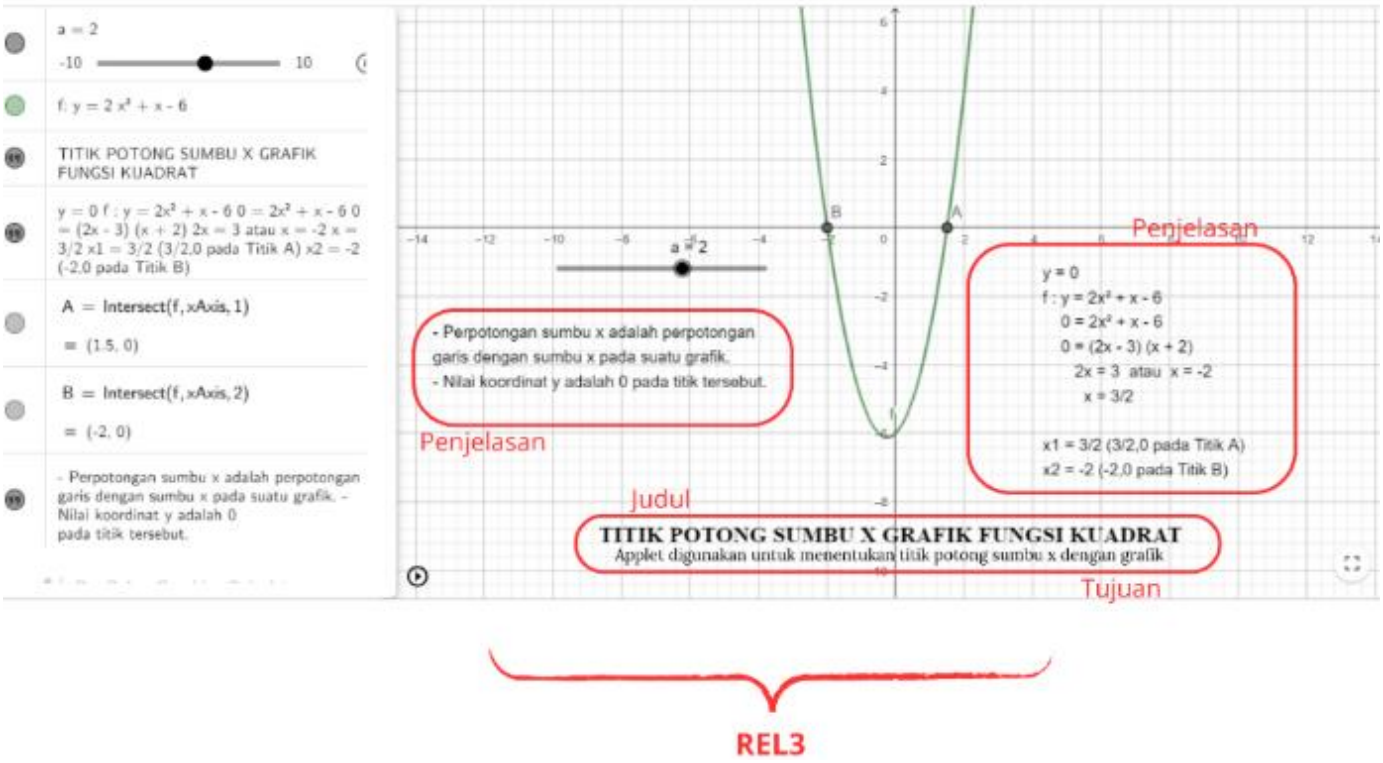


Figure 1. Work Result of HC1 and HC2

The results of the Geogebra applet of the subject with creativity are presented in Figure 2. Based on the components of creativity, subjects with medium creativity 1 (MC1) and subjects with medium creativity 2 (MC2) succeeded in achieving the aspect of novelty by making Geogebra applets that have novelty from examples in certain parts. The Geogebra applet is made about the vertex point of the quadratic function graph even though it has not been equipped with an illustration of the vertex point in the quadratic function graph. MC1 and MC2 managed to achieve the relevant aspect by creating a different Geogebra applet from the example given, including a title and description. However, the purpose is still not written in the Geogebra applet. In the effective aspect, the Geogebra applet made by MC1 and MC2 can function well but cannot achieve the set goal due to the lack of illustration of the apex point.

Based on the indicators of the creative process, in the stage of synthesizing ideas, subjects with medium creativity (MC) start by reading the assigned task sheet to gather information. MC cannot read and understand tasks well, so the information obtained is incomplete. MC tends to only capture information about the command to create a Geogebra applet about a quadratic function that is different from the example and pays little attention to information related to the criteria of things that need to be included in the Geogebra applet created. Even so, MC can relate the information obtained to what is requested in the task. In the ideation stage, subjects with medium creativity (MC) carry out the collection of information from other sources outside the task such as their knowledge, books, and the internet to come up with ideas. In generating ideas, MC still pays attention to the information obtained from the task and also what is requested in the task. In the stage of planning the implementation of the idea, subjects with medium creativity (MC) can choose an idea to apply in making the Geogebra applet. However, the reason used is not to give the best results in the task but rather to the level of ease of making it. Even so, MC can clearly explain the plan for implementing the selected ideas. In the stage of applying ideas, subjects with medium creativity (MC) can well implement the plan that has been

prepared. However, the Geogebra applet that was made was still not following the task given because of the poor absorption of information in the stage of synthesizing ideas.

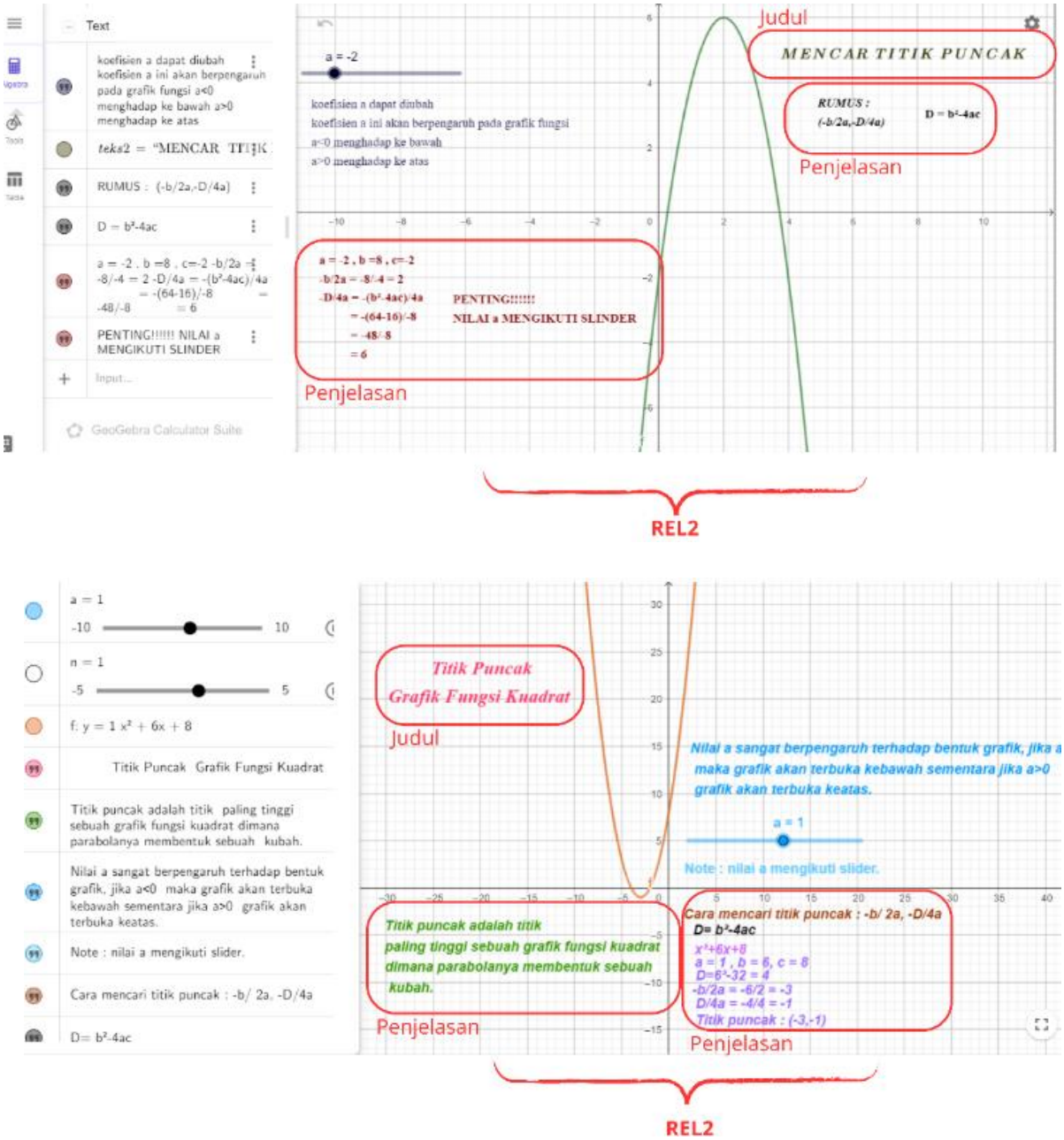


Figure 2. Work Result of MC1 and MC2

The results of the Geogebra applet of the subject with low creativity are presented in Figure 3. Based on the components of creativity, subjects with low creativity 1 (LC1) and subjects with low creativity 2 (LC2) cannot achieve the aspect of novelty by only being able to make the same Geogebra applet as the example given. LC1 has not succeeded in achieving the relevant aspect because even though it has included the title and explanation related to the Geogebra applet that was made, it is the same as the one in the example given. Meanwhile, LC2 is only able to make the same Geogebra applet and only includes an explanation. LC1 and LC2 have not succeeded in achieving the effective aspect because although they can be used and function properly, they have not been able to achieve the purpose of the task given to make a Geogebra applet that is different from the example given.

Based on the indicators of the creative process, in the stage of synthesizing ideas, subjects with low creativity (LC) start by gathering information. However, in collecting information, LC is only limited to looking for information related to orders in the task. SR pays little attention to other information in the task. So the information that SR has about the task is very lacking. LC has not been able to relate the information obtained to what is requested in the task. In the ideation stage, subjects with low creativity (LC) carry out the collection of information from other sources outside the task such as the knowledge they have, books, and the internet to come up with ideas. In generating ideas, LC does not pay attention to the information obtained from the task and also what is requested in the task, but pays more attention to the level of difficulty. In the stage of planning the ideas, subjects with low creativity (LC) can choose ideas to apply in making Geogebra applets. However, the reason used is more about the level of complexity and convenience. LC has also not been able to explain the plan to implement the selected ideas clearly. In the stage of applying ideas, subjects with low creativity (LC) tend to carry it out spontaneously according to their wishes because SR has not been able to make a plan to implement the idea. The Geogebra applet made by SR is not following the assigned task due to the lack of information that SR has regarding the assigned task.

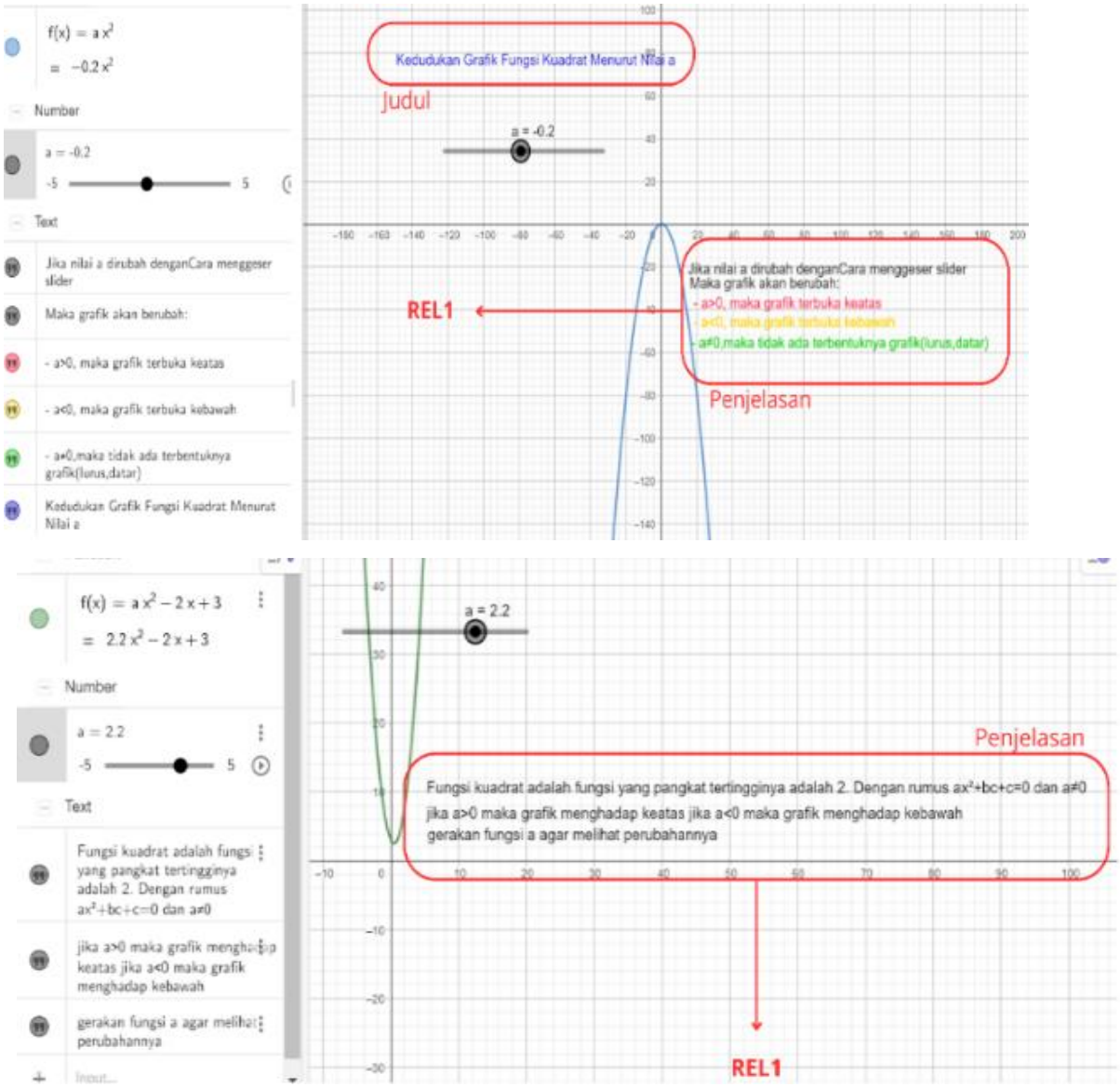


Figure 3. Work Result of LC1 and LC2

Creativity and Creative Process of Students with a High Level of Creativity in Making Geogebra Applets

Students who are included in the category of students with high creativity, namely as many as 14 students or 42% of all subjects who do assignments. From this number, two subjects with good communication skills were selected based on recommendations from Mathematics teachers to analyze their creativity and creative process in making Geogebra applets. The results of the task of making the Geogebra applet showed that subjects with high creativity (HC) could fulfill all aspects of creativity, namely novelty, relevant, and effective with maximum scores. HC can create an applet that is different from the example given, where the applet corresponds to the commands in the task and can fulfill the predetermined objectives.

The stages of the creative process for students with high creativity begin with the stage of synthesizing ideas. At this stage, HC can understand the content of the task well so that he can collect complete information. In line with the research (Karim, Wijayanti & Maharani, 2020) which states that students with high creative thinking skills can understand problems well. HC can also associate the information it obtains with the commands on the task. The HC then gathers information from other references beyond the information on the task to develop an idea. HC is productive in generating ideas to fulfill the tasks given by paying attention to the information and commands obtained in the task. HC can choose an idea or strategy to implement because they want to produce a good Geogebra applet suitable for the task. HC can make a plan related to the implementation of the idea he chooses and can implement it well. This is in line with the research (Syifa'uliyah, Siswono & Setianingsih, 2023) which states that students with high creative thinking skills can plan strategies to implement their ideas. ST was able to implement his ideas according to the plan and re-examine his work so as to produce a Geogebra applet that was suitable for the assigned task.

Creativity and Creative Process of Students with a Medium Level of Creativity in Making Geogebra Applets

Students who are included in the category of students with medium creativity, namely as many as 12 students or 35% of all subjects who do assignments. From this number, two subjects with good communication skills were selected based on recommendations from Mathematics teachers to analyze their creativity and creative process in making Geogebra applets. The results of the task of making the Geogebra applet showed that subjects with medium creativity (MC), were less able to fulfill the aspects of creativity, namely novelty, relevant, and effective perfectly. MC can create a different Geogebra applet from the example given in several parts. The Geogebra applet made by the MC is still not suitable because there are several task criteria that have not been met, namely not listing the purpose. The goal that was set late, namely determining the peak point could be fulfilled but was still not perfect because only giving an example of finding the peak point in a case was not in general.

The stages of the creative process for students with creativity are starting with the stage of synthesizing ideas. At that stage, MC is not able to understand the content of the task well so there is information left behind regarding the provisions of things that need to be included in the Geogebra applet. The MC can still relate the information it obtains to the commands on the task. MC then gathers information from other references beyond the information on the task to develop an idea. MC is less productive in generating ideas to fulfill the tasks given. However, the MC still pays attention to the information and orders obtained in the task. MC can choose an idea for simple reasons and easy to implement. This is the following research (Karim, Wijayanti & Maharani, 2020) which states that students with creative thinking skills are fluent in choosing ideas with easier consideration of ideas. MC can make a plan related to the implementation of the idea he chooses and can implement it well. However, the Geogebra applet made by MC is still not following the task given because of the poor information collection process at the beginning.

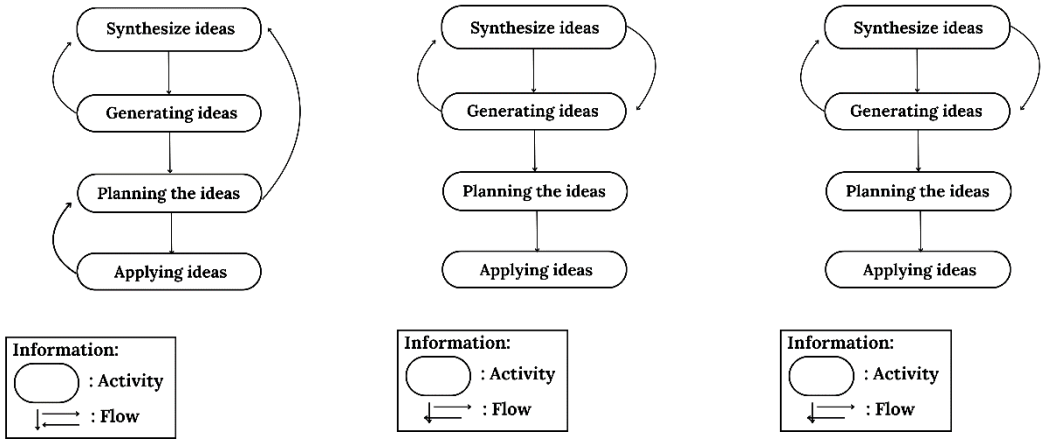
Creativity and Creative Process of Students with a Low Level of Creativity in Making Geogebra Applets

Students who are included in the category of students with low creativity, namely as many as 8 students or 24% of all subjects who do assignments. From this number, two subjects with good communication skills were selected based on recommendations from Mathematics teachers to analyze their creativity and creative process in making Geogebra applets. The results of the task of making the Geogebra applet showed that subjects with low creativity (LC) could not fulfill the aspects of creativity, namely novelty, relevant, and effective. LC is only able to create the same Geogebra applet as the example, so it does not conform to the commands in the task and cannot achieve the set goals.

The stages of the creative process for students with low creativity begin with the stage of synthesizing ideas. At that stage, LC cannot understand the content of the task well because LC does not pay attention to the content of the given task. LC only focuses on knowing the commands of the task and ignores other information. This is the following research (Karim, Wijayanti & Maharani, 2020) which states that students with low creative thinking skills are less able to understand information. So, LC can only collect information that students are asked to make a Geogebra applet regarding the quadratic function. LC also cannot relate the information it obtains to the commands on the task. LC then gathers information from other references beyond the information on the task to develop an idea. However, LC is not productive in generating ideas and tends not to want to think complicatedly. This is following the research (Karim, Wijayanti & Maharani, 2020) which states that students with low creative thinking skills are less in generating ideas and are not productive in choosing ideas. LC cannot make a plan related to the implementation of the idea he chooses so in the implementation of the idea, LC tends to spontaneously follow his wishes. The Geogebra applet created by LC does not correspond to the assigned task because it is the same as the example given.

Comparison of Student Creative Process Flow with High, Medium, and Low Creativity

The following is a comparison of the creative process flow of students with high, medium, and low creativity in making Geogebra applets.



(a) The flow of students' creative process with high creativity

(b) The flow of the creative process of students with medium creativity

(c) The flow of students' creative process with low creativity

Based on the image above, it can be seen that students with high, medium, and low creativity have different creative process flows. The three levels of creativity have similarities in repeating the stages of synthesizing ideas and generating ideas. In generating ideas, students redo the stage of synthesizing ideas by collecting information related to quadratic function material to come up with ideas. The flow of the creative process that students with medium and low creativity go through is the same. However,

in the stage of synthesizing ideas, students with medium creativity can collect more complete information and relate more concepts to the task so that they are more productive in generating ideas at the stage of generating ideas. Students with high creativity not only repeat at the stages of synthesizing ideas and generating ideas, but also at other stages. After the stage of planning the ideas, students again do the stage of synthesizing ideas to choose the right ideas or strategies to be applied in the assignment. After implementing the idea, students with high creativity re-examine the results of their work in the form of Geogebra applets and redo the stage of planning the ideas to improve the Geogebra applet made.

Conclusion

The higher the level, the more detailed the Geogebra applet produced by students in representing their understanding and the more complex the use of tools in the Geogebra applet, providing many elements of novelty from the examples given, following the task, and effective in achieving the set goals. Furthermore, the creative process of students with the stages of synthesizing ideas, generating ideas, planning the ideas, and applying ideas at each level has a different process. At the stage of synthesizing ideas, students with high creativity can understand and collect information to the maximum, and can also relate the information they have with the commands in the task. Meanwhile, students with medium and low creativity are less than optimal in collecting information and are less able to relate the information obtained to the commands in the assignment. At the stage of generating ideas, students with high creativity are productive in generating ideas. Meanwhile, students with medium creativity are less productive and students with low creativity tend to be less productive in generating ideas. At the stage of planning the ideas, students with high creativity choose the right and best ideas based on what is asked in the assignment and can make a plan for its implementation. Meanwhile, students with medium and low creativity tend to choose ideas with consideration of the level of ease in realizing the idea into the Geogebra apple. At the stage of applying ideas, students with high creativity can apply ideas well and produce Geogebra applets that are suitable for the task. Students with medium creativity can apply their ideas, but the results obtained are not in accordance with the assignment. Meanwhile, students with low creativity can only produce the same Geogebra applet as the example so it is not following the assigned assignment.

Based on the results of this study, after knowing the difference in product results between students with high, medium, and low creativity, where students with low creativity get poor results in doing assignments, it is suggested that teachers can provide learning activities that can train students' creativity so that all students can get better results in learning. After knowing the creative process of students based on their level of creativity where students with low creativity tend to have difficulties in the process of synthesizing ideas so in giving assignments or questions, the teacher can help students to show the intention or concept in the assignment or question so that students can be helped in synthesizing ideas and can go through a better creative process. Based on the results of this study which analyzes the creativity and creative process of students individually, it is hoped that other researchers can develop research on the creativity and creative process of students in doing assignments in groups. In addition, other researchers may use different technologies or different materials. In the data collection process, to obtain more valid data in the data collection process which takes a long time and cannot be directly supervised, researchers should periodically check the progress of the assignment and ensure that students do the assignment independently.

References

Agustini, F. & Fajriyah, K. (2017). Problematika Pengembangan HOTS (Higher Order Thinking Skills) di Sekolah Dasar, in *Prosiding Seminar Nasional Inovasi Pendidikan*, pp. 139–145.

Anugerahwati, M. (2019). Integrating the 6Cs of the 21st Century Education into the English Lesson and the School Literacy Movement in Secondary Schools. *KnE Social Sciences*, 3(10), pp. 165–171. Available at: https://doi.org/10.18502/kss.v3i10.3898.

Apriansyah, D. & Ramdani, M. (2018). Analisis Kemampuan Pemahaman dan Berpikir Kreatif Matematika Siswa MTs pada Materi Bangun Ruang Sisi Datar. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 2(2), pp. 1–7.

Astriani, M.M. (2020). Upaya Mengembangkan Kreativitas Mahasiswa Melalui Pembelajaran Model Project Based Learning. *Jurnal PETIK*, 6(1).

Buyung. (2021). Kemampuan Berpikir Kreatif Matematis Siswa SMP Melalui Soal Open Ended. *Media Pendidikan Matematika*, 9(2), pp. 126–132.

Cropley, A.J. & Urban, K.K. (2000). Programs and Strategies for Nurturing Creativity. In *IIn K. A. Heller, F. J. Mönks, R. J. Sternberg & R. F. Subotnik, International handbook of giftedness and talent*. Pergamon: Oxford, pp. 481–494.

Djam'an, N., Bernard & Sahid (2021). Developing Students' Creativity in Building City Mathematics through Project Based Learning. In *Journal of Physics: Conference Series*. IOP Publishing Ltd, pp. 1–7. Available at: https://doi.org/10.1088/1742-6596/1899/1/012147.

Fadlilah, C., Karim, K., & Hartono, S. (2021). Creative Thinking Ability of Visual-Dominant and Visual-Kinesthetic Students in Solving Statistics Problems. *Journal of Mathematical Pedagogy* (JoMP), 2(2), 40-51.

Fasko, D. (2001). Education and Creativity. *Creativity Research Journal*, 13(3–4), pp. 317–327. Available at: https://doi.org/10.1207/s15326934crj1334_09.

Hohenwarter, M. & Fuchs, K. (2004). *Combination of dynamic geometry, algebra and calculus in the software system GeoGebra*. Available at: https://www.researchgate.net/publication/228398347.

Karim, G.S., Wijayanti, D. & Maharani, H.R. (2020). Analisis Proses Berpikir Kreatif Siswa dalam Meyelesaikan Soal Matematika Berdasarkan Tahapan Siswono, in *Konferensi Ilmiah Mahasiswa Unissula*, pp. 684–691.

Kemendikbudristek. (2022). *Capaian Pembelajaran Mata Pelajaran Matematika Tingkat Lanjut Fase F Untuk SMA/MA/Program Paket C 2*.

Mariani, R., Ansori, H. & Mawaddah, S. (2021). Kemampuan Berpikir Tingkat Tinggi Menurut Teori Anderson dan Krathwohl pada Siswa SMP Kelas IX. *Jurnal Mahasiswa Pendidikan Matematika*, 1(1), pp. 49–55. Available at: http://jtam.ulm.ac.id/index.php/jurmadikta.

Munandar, U. (1998). *Kreativitas*. Jakarta: Dian Rakyat.

Partono, P., Wardhani, H. N., Setyowati, N. I., Tsalitsa, A., & Putri, S. N. (2021). Strategi meningkatkan kompetensi 4C (critical thinking, creativity, communication, & collaborative*). Jurnal Penelitian Ilmu Pendidikan*, 14(1), 41-52.

Puspitasari, Q.D. & Wibowo, A. (2022). Peran Guru dalam Mengembangkan Kreativitas Siswa Kelas IV di SD Negeri Plebengan Bambanglipuro, *Pelita: Jurnal Kajian Pendidikan dan Pembelajaran Indonesia*, 1(1), pp. 1–7. Available at: https://doi.org/10.56393/pelita.v1i1.105.

Rasnawati, A., Rahmawati, W., Akbar, P., & Putra, H. D. (2019). Analisis kemampuan berfikir kreatif matematis siswa SMK pada materi sistem persamaan linier dua variabel (SPLDV) di Kota Cimahi. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 3(1), 164-177.

Siswono, T.Y.E. (2008). Proses Berpikir Kreatif Siswa dalam Memecahkan dan Mengajukan Masalah Matematika. *Jurnal Ilmu Pendidikan*, 15(1), pp. 60–68.

Sumarni, W. and Kadarwati, S. (2020). Ethno-stem project-based learning: Its impact to critical and creative thinking skills. *Jurnal Pendidikan IPA Indonesia*, 9(1), pp. 11–21. Available at: https://doi.org/10.15294/jpii.v9i1.21754.

Syifa'uliyah, Siswono, T.Y.E. & Setianingsih, R. (2023). Proses Berpikir Kreatif Siswa SMA dalam Menyelesaikan Masalah Kontekstual Materi Barisan Aritmetika," *Jurnal Pendidikan dan Pembelajaran*, 4(2), pp. 1999–2010. Available at: http://jurnaledukasia.org.

Wallas, G. (1926). *The art of thought*. New York: Harcourt, Brace & Jovanovich.

Wibowo, R.A. (2022). *Pengembangan Model Pembelajaran Berbasis Discovery Learning Berbantuan Geogebra Applet Untuk Meningkatkan Kemampuan Berpikir Kreatif Siswa*. (Doctoral dissertation, UNIMED).