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Research Article

Students creative thinking skills on differentiated instruction

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ABSTRACT

Creative thinking is one of the skills that must be possessed by students in the 21st century. This study aims to investigate and describe students' creative thinking skills in completing the Cartesian Coordinate Skills Task (CCST). This research was conducted in one of the public junior high schools in Jambi City. The research subjects were six 8th grade junior high school students who have learnt by product differentiate instruction. The research subjects were divided into 3 categories based on the results of the Knowledge Question (KQ), namely high, medium, and low. Students' creative thinking skills were tested through CCST and the results were analyzed based on creative thinking indicators. The results of this study indicate that each subject tends to be able to show aspects of fluency and flexibility, but only three subjects are able to show aspects of novelty. In addition, from the three subjects, there is 1 subject in the low category who is able to show the novelty aspects.

Keywords: creative thinking; differentiated instruction; product

1. INTRODUCTION

Mathematics is one of the subjects that plays an important role in education and everyday life. The need to understand and be able to use mathematics in everyday life will continue to increase (Ferrini-Mundy, 2000). The Indonesian nation is facing the challenges of the industrial revolution 4.0 in the 21st Century, where Indonesian students are expected to have the competence to become democratic citizens and become superior and productive human beings in the 21st Century (Satria et al., 2022). To answer this challenge, the government through Kepmendikbudristek Number 56 of 2022 concerning Guidelines for Implementing Curriculum in the Context of Learning Recovery (Kemdikbudristek, 2022b) gives freedom to education units to choose to implement the Kurikulum 2013 in its entirety, the Kurikulum Darurat (simplified Kurikulum 2013), or Kurikulum Merdeka.

The purpose of National Education as stated in Article 3 of Law Number 20 of 2003 concerning the National Education System is to create human beings who believe and be pious to God Almighty, have noble character, healthy, knowledgeable, capable, creative, independent and become democratic and responsible citizens (Depdiknas, 2003). The National Education Goals in the Kurikulum Merdeka are stated in the Profil Pelajar Pancasila. Indonesian students are lifelong students who are competent, have character, and behave according to the values of Pancasila which consist of six dimensions, namely: faith and be pious to God Almighty, noble character, independent, worked together, global diversity, critical reasoning; and creative (Kemdikbudristek, 2022c, 2022a; Satria et al., 2022). This is in accordance with the demands of 21st Century Skills that must be possessed by students, namely critical thinking, creative thinking, collaboration and communication (Ohio Department of Education, 2015).

The current approach to learning mathematics, promotes the teaching of creative thinking to develop a deep conceptual understanding of mathematics, and many countries incorporate creative thinking explicitly into the curriculum (Aizikovitsh-Udi & Amit, 2011; Hadar & Tirosh, 2019; Mann, 2006), one of which is Indonesia. This means, one of the abilities that must be developed in a student through mathematics learning is creative thinking. Creative thinking is one of the most important skills in solving math problems or generating new ideas (Hadar & Tirosh, 2019), 21st century learning, and the key to effective learning (Egan et al., 2017; Jahnke et al., 2015; Nissim et al., 2016). Based on the 21st century framework, creative thinking can help students deal with the rapidly changing competencies in the world (Suherman & Vidákovich, 2022). Furthermore, according to PISA Mathematical creative thinking is a competency to be involved productively in learning, evaluating, and improving ideas that can produce new and practical solutions (OECD, 2019). Creative thinking skills must be used at the highest level to achieve more permanent learning and ensure interdisciplinary transition (Cenberci, 2018).

Creative thinking is the ability to develop unusual ideas according to goals (Anggareni & Hidayat, 2019; Hidayat & Anggareni, 2019; Yuli & Siswono, 2004), as well as habits of exploration, imagination, and intuition (Anggareni & Hidayat,

2019). Creative thinking is characterized by the creation of something new from the results of ideas, descriptions, concepts, experiences, and knowledge (Suherman & Vidákovich, 2022), not only generating and building ideas but also competencies needed by students (Lucas et al., 2012; OECD, 2019; Suherman & Vidákovich, 2022). Students' creative thinking can be assessed based on several important aspects of creative thinking, namely fluency, flexibility, novelty/originality (Anggareni & Hidayat, 2019; Hidayat & Anggareni, 2019; Silver, 1994; Sriraman & Lee, 2013; Torrance, 1963), elaboration, redefinition (Suherman & Vidákovich, 2022; Torrance, 1963). However, in this study only three aspects of creative thinking were used, namely fluency, flexibility, and novelty. Fluency is the ability to generate many ideas; flexibility is the ability to generate many ideas from various points of view; novelty is the ability to generate personal ideas that are different from most (Githua & Ng'eno, 2016).

In this study, fluency refers to the ability to display multiple presentations of written data. Multiple presentations of written data are related to the representation of the position of certain objects. Flexibility refers to the ability to represent objects and many different types of data presentation. Novelty refers to a way of demonstrating understanding in a way that is different from most. Creative thinking is very important to develop a deep conceptual understanding of mathematics (Hadar & Tirosh, 2019; Mann, 2006; Sheffield, 2013). But in reality, developing creative thinking is difficult (Hadar & Tirosh, 2019), teachers cannot directly teach creative thinking skills (Hadar & Tirosh, 2019; Sarrazy & Novotná, 2013), but teachers can create learning that can encourage creative thinking (Švecová et al., 2014). Creative thinking requires a stimulus (Ulfah et al., 2017), is student-centered (Kwon et al., 2006), produces something unusual or an original idea (Volle, 2018), as well as the types of materials, activities/tasks support (Hadar & Tirosh, 2019). One of the lessons that encourage creative thinking is differentiation learning. Differentiated Instruction has the potential to promote the abilities of all students (Prast et al., 2018). In addition, the research findings of (Palieraki & Koutrouba, 2021) concluded that there was an increase in the quality of learning outcomes and the level of active participation of students and due to differentiated learning.

Differentiated instruction is a varied learning approach to meet the diverse needs of students in the classroom (Prast et al., 2018; Shareefa & Moosa, 2020; Tomlinson, 2014). Furthermore, Smale-Jacobse et al. (2019) defines differentiated instruction as a teaching philosophy that is based on a deep respect for students, recognition of each other's uniqueness, and encouragement to help each learner develop. Differentiated instruction is a learning approach that combines various strategies, such as flexible grouping, adaptive instruction and progress that supports teachers to facilitate student learning (Deunk et al., 2018; Watts-Taffe et al., 2012). By offering learning resources, learning task, and goals that are specifically suited to each student's learning requirements, differentiated teaching enables all students to access the same classroom material or curriculum learning (Deunk et al., 2018; Watts-Taffe et al., 2012).

Students diversity in readiness, interest, and learning profile (Tomlinson, 1999; 11, 2001:45). Readiness refers to a student's relative prior knowledge to a certain understanding or skill. Interest refers to student's affinity, curiosity, or ambition to a certain topic or skills. Learning profile refers to how students learn, it might be influenced by preferences for IQ, gender, culture, or learning style. The uniqueness of Differentiated Instruction base on flexible teaching approach that can be modified with students' needs (Valiandes & Bermúdez Martínez, 2017). The teacher can change the content, process or product by analyzing the assessment data (Tomlinson, 1999:11, 2001:4). Contents refer to what students want to learn and how the material presented. Processes refer to how student get the knowledge or concept and to guarantee that students employ key skills to make important concepts and knowledge. Products refer to how students demonstrate and exhibit what they have learnt (Tom-linson, 1999: 11, 2001: 4).

At any moment during a lesson or unit, teachers may modify one or more curricular components (contents, processes, or products) based on one or more student's characteristics (readiness, interest, or learning profile). However, you do not have to distinguish every element in every way that is conceivable (Tomlinson, 1999: 11). Change a curriculum component only when you recognize a student need or you are certain that changing it will raise the likelihood that the learner will comprehend crucial concepts and use crucial skills more thoroughly as a consequence (Tomlinson, 1999: 11). On this research, subjects are students who got differentiated instruction on product. A product is a way for a student to demonstrate (and expand upon) what they have learned and are capable of doing after spending a significant amount of time learning. A demonstration or an exhibition might be the final product. A final product could be an exam or a visual presentation, such a photo essay with narration (Tomlinson, 1999: 43). The students demonstrate what they have learned and are capable of doing with final product about Cartesian Coordinates through Cartesian Coordinate Skills Task (CCST), students also use Google Maps to see accurate place of the certain objects. The product of CCST such as pictures/photos with hand or computer writing, pictures and audio recordings, video recordings or screen recording videos. Students can choose the form of the product that they want to upload according to their interest or ability.

2. RESEARCH METHOD

This study aims to describe students' creative thinking in completing skill assignments in product differentiated instruction. The data obtained in the form of products related to students' understanding of the material Cartesian coordinates. The data is qualitative data in the form of writing or student work. This study describes a phenomenon that occurs according to circumstances *(descriptive)*. Based on this, this research is a qualitative descriptive study. This study was conducted in one of the public junior high schools in Jambi City. The subjects in this study were students who were taught by product differentiated instruction. The selection of subjects begins with the provision of a Cartesian Coordinate Skills Task (CCST) which can be completed within the agreed time period. Then, prospective subjects are given Knowledge Questions in the form of multiple choices to see students' understanding of Cartesian Coordinates. KQ are given through Google Classroom and by utilizing the Quiz application to further challenge students and the results provided are accurate according to the time determined by the researcher. Based on these results, the prospective subjects were grouped into 3 categories, namely

high (76-100), medium (51-75), and low (26-50). Furthermore, based on the product produced in CCST, two students from each category were selected to be used as research subjects. Subjects are selected based on the best product or display a certain phenomenon. The data collection instrument in this study was CCST. The CCST can be seen in **Figure 1**.

TUGAS KETERAMPILAN KOORDINAT KARTESIUS (TKKK)

Untuk mendemonstrasikan pemahaman ananda terkait Koordinat Kartesius, silahkan ananda mengerjakan tugas proyek dengan langkah sebagai berikut

1. Silahkan ananda menyelidiki posisi rumah Ananda menggunakan aplikasi *google maps*. Tentukan rumah Ananda sebagai titik asal (0,0)
2. Berdiskusilah dengan seseorang, anggota keluarga, atau orang lain untuk menggunakan topik Koordinat Kartesius untuk melihat posisi objek lain berdasarkan tampilan *google maps* Ananda. Pilihlah 3 objek yang ada minati.
3. Silahkan representasikan pemahaman mu terkait Koordinat Kartesius berdasarkan penyelidikanmu menggunakan *google maps* dalam beberapa penyajian (misal koordinat kartesius, tabel, dsb).
4. Tentukan koordinat suatu titik dengan menggunakan titik acuan (0,0) dan (a,b)
5. Demonstrasikan pemahaman ananda terkait bidang koordinat kartesius berdasarkan penyelidikanmu menggunakan *google maps* dalam bentuk gambar/foto berupa tulisan tangan atau komputer, gambar dan rekaman audio, video rekaman atau video rekaman layar. Silahkan ananda pilih bentuk produk yang ananda upload sesuai minat ananda.

Figure 1. The Cartesian Coordinate Skills Task (CCST)

3. RESULTS AND DISCUSSION

3.1 Fluency

In this study, fluency refers to the ability to display multiple presentations of written data. Multiple presentations of written data are related to the representation of the position of certain objects. The presentation of data includes, among others, sketch (google maps), Cartesian coordinates, tables. etc. The fluency aspect of each subject can be seen in **Table 1**.

Table 1. Analysis CCST Based on Fluency Aspects

Category	Subjects & KQ Values	Presentations of Written Data
High	S1 (100)	5
	S2 (100)	4
Medium	S3 (73)	4
	S4 (73)	4
Low	S5 (36)	4
	S6 (36)	4

Table 1 is a summary of the fluency aspects of the six subjects. Based on table 1, in each category it can be seen that the number of data presentations performed by each subject is four, except S1. This is because, S1 does not only present data in written form but also presents data in the form of an explanation video about the student's understanding of Cartesian Coordinates by utilizing the google maps application. Each subject category tends to present data in the form of sketch (google maps), Cartesian Coordinates and tables. In addition, the table presented consists of two tables, the subject not only displays his understanding of the coordinates of the point based on the origin (0, 0) but also to a certain point (a, b). In the high category, the subject tends to be able to present at least four data presentations and the subject tends to present the data correctly regarding their understanding of the CCST results. The reason is the subject has understood the Cartesian coordinate material which can be seen from the KQ value of the two subjects of 100. In the medium category, the subject tends to be able to present four data presentations and the subject tends to present the data correctly regarding their understanding of the CCST results, although in the KQ results the two subjects doing mistakes in understanding the indicator, namely determining the position of certain reference point (a, b), but the subject can show their understanding correctly in doing CCST. From figure 2 it can be seen that the subject is confused about where to move, starting from Gentala Arsy or Muara Jambi? So that the subject made an error and moved the point from Gentala Arsy to Muara Jambi, it should have been the other way around.

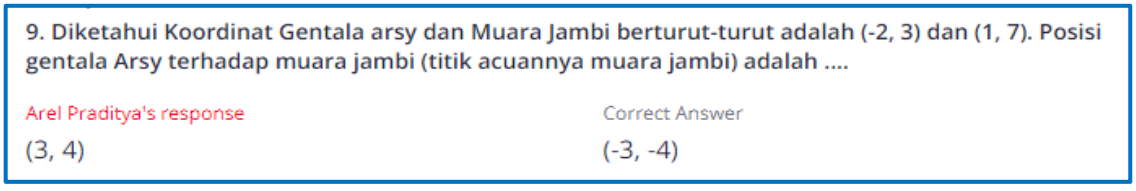

Figure 2. The Snapshot of High Categories Subject Answers on Knowledge Questions (KQ)

Based on the results on the CCST, subjects in the medium category can write down the data presentation correctly. The

reason is CCST was collected after the subject did the KQ, so that the subject could find out his mistake. Based on interview, subjects feel challenges with CCST because they can use their knowledge in daily life and using application (google maps). However, from Figure 4, it can be seen that S3 still has a mistake in determining the position of a point with respect to a certain reference point (a, b) using the formula. It can be seen that based on the CCST that S3 presents in the table of point coordinates to a certain reference point (a, b), S3 changes the given formula from the minus operation (-) to the (+) operation. S3 is confused because S3 uses a reference point (0,-5) so that when using the formula, S3 tends to see the y-ordinate as the sum of y1 and y2. In fact, the positive sign (+) is actually obtained because there is a subtraction in negative numbers, so that initially (0-(-5)) becomes (0 + 5). The S3' answer was not wrong, but the final conclusion regarding the general formula was wrong because S3 was fooled by the negative sign at the reference point.

NO	Koordinat Titik Terhadap titik asal (0,0)/(x1,y1)	Posisi terhadap titik acuan Kos-kosan Melani Putri (0,-5) (x2,y2)		Rumus (x1+x2, y1+y2)
		Posisi	Koordinat	
1	Rumah (0,0)	0 satuan ke kanan dan 5 satuan ke atas	(0, 5)	(0+0, 0+5)(0,5)
2	Illa Santan (5,-6)	5 satuan ke kanan dan 11 satuan ke atas	(5, 11)	(0+5, 5+6)(5,11)
3	Putri Tunggal Mini Market (4,2)	4 satuan ke kanan dan 7 satuan ke atas	(4, 7)	(4+0, 2+5) (4,7)

Figure 3. CCST S3 Snapshot

In the low category, subjects tended to be able to present four data presentations, but both subjects made errors in presenting data related to their understanding of the CCST results. Based on Figures 4 and 5, it can be seen that the two subjects did not understand several indicators, namely determining the distance of the point to the x axis (S6) or Y axis (S5 and S6), determining the position of the point to the origin (0,0) (S5), the coordinates of the point to the origin (S6) and determine the position of the point with respect to a certain reference point (a, b).

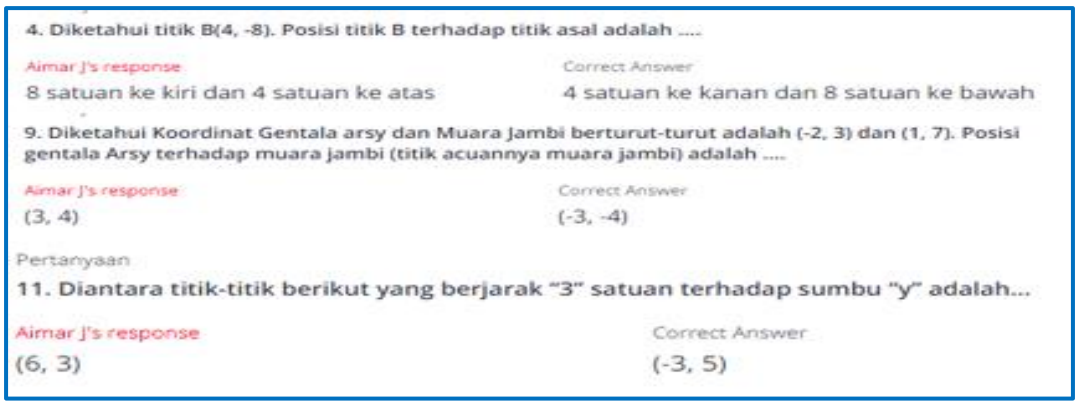

Figure 4. S5 Answer Highlight on Knowledge Questions (KQ)

Figure 5. S6 Answer Highlight on Knowledge Questions (KQ)

Based on the results on the CCST, it can be seen that subjects in the low category can write down the data presentation correctly on the indicator, determine the distance of the point from the x or Y axis, determine the position and coordinates of the point to the origin (0,0). Even though the subject did not do the KQ correctly on these indicators. This is because the CCST was collected after the subject did the SP, so that based on this the subject could find out his mistake. However, when the indicator determines the position of the to a certain reference point (a, b), both subjects made an error in presenting the data. This can be seen based on CCST S5 in **Figure 6**.

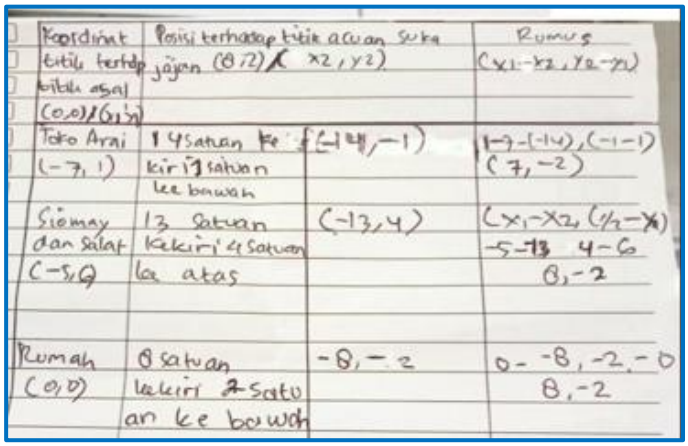

Figure 6. CCST S5 Snapshot

In **Figure 6**, it can be seen that S5 made a mistake in determining the coordinates of a point to a certain references point (a, b). S5 also used the formula to determine the coordinates incorrectly, in contrast to S6. In **Figure 7**, it can be seen that S6 did not make a mistake in determining the coordinates, it is just that the table shown by S6 is the coordinates of the point to the origin (0, 0).

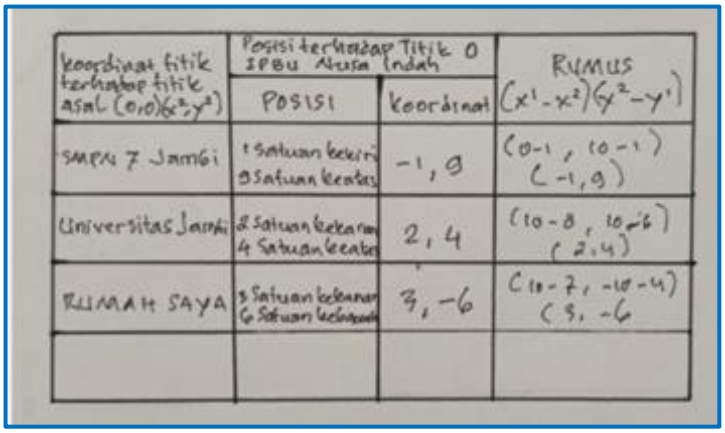

Figure 7. CCST S6 Snapshot

3.2 Flexibility

In this study, flexibility refers to the ability to represent objects and many different types of data presentation. Represent objects related to the position of the object on the x or y axes. Meanwhile, the type of data presentation is related to the presentation of data in the form of sketch/google maps, cartesian coordinates, tables, or videos. Look at the following table to see fluency aspect of each subject.

Table 2. Analysis CCST Based on Flexibility Aspects

Category	Subjects & KQ Values	Represent of Objects	Data Presentation
High	S1 (100)	3	4
	S2 (100)	4	3
Medium	S3 (73)	4	3
	S4 (73)	4	3
Low	S5 (36)	4	3
	S6 (36)	4	3

Based on **Table 3**, it can be seen that the subjects in each category have a tendency for the level of flexibility in presentation to be four, except for S1. This is because, students are asked to determine 4 objects on google maps that will be presented in various ways to see students' understanding of the Cartesian Coordinate material. There are 2 objects represented by S1 on the same axis. In addition, the flexibility in presenting data, subjects in each category tend to display

3 types of data presentation, except S1. The three types of data presentation are in the form of handwritten location sketch or Google Maps screenshots, presenting objects at Cartesian coordinates, and presenting objects on table. In contrast to S1, after presenting in these three ways, S1 also presents using a video that explains S1's understanding of the Cartesian Coordinate material.

3.3 Novelty

Novelty refers to a way of demonstrating understanding in a way that is different from most. Look at the following table to see novelty aspect of each subject.

Table 3. Analysis CCST Based on Novelty Aspects

Category	Subjects & KQ Values	Ways of Demonstrate
High	S1 (100)	1
	S2 (100)	1
Medium	S3 (73)	0
	S4 (73)	0
Low	S5 (36)	0
	S6 (36)	1

Based on **Table 4**, it can be seen that there are only 3 subjects who can show novelty, namely S1, S2, and S6. Subjects in the high category tend to show novelty, while the subjects in the medium and low categories have not been able to show the novelty aspect, except for S6. A snapshot of CCST S1 can be seen in Figure 8. The screenshot is a 3 minute 25 second video screenshot, which can be accessed at the link https://bit.ly/ProdukTKKK

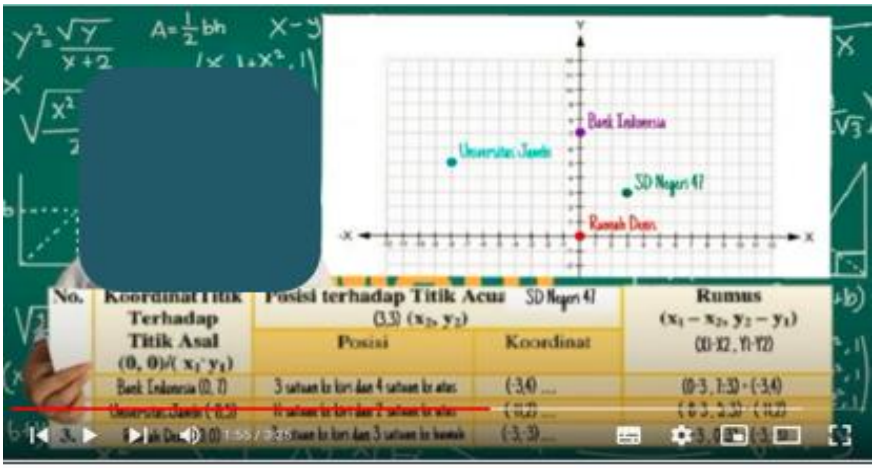

Figure 8. CCST S2 Snapshot

A snapshot of the S6 CCST can be seen in Figure 9. The CCST image produced is actually quite simple, but of most subjects and even students who are working on CCST, only S6 combines Google maps screenshots and the coordinate system, so the position of the selected object is correct, precision according to the actual situation. This means, even though the subject is in the low category, the subject can maximize their creative potential by being given the opportunity to explore more potential and problems. This opinion is in accordance with Cenberci (2018) which states that the opportunity to develop creative thinking skills and have more time to design creative products is very important to determine how to use the tendency of creative thinking skills and the factors that will activate these tendencies. Creative thinking is characterized by creating something new from results, ideas, descriptions, concepts, experiences, and knowledge which includes fluency, flexibility, originality, and elaboration (Suherman & Vidákovich, 2022).

Figure 9. CCST S6 Snapshot

3.4 Discussion

Based on the results of the research that has been described above, although the subject cannot do the KQ, the subject tends to try to do their best in doing the CCST. This shows that product differentiated instruction can improve students' abilities, including creative thinking. Differentiated instruction has the potential to improve the achievement of all students (Prast et al., 2018) and develop students' creative thinking skills (Cenberci, 2018).In addition, creative thinking can be developed with good teaching planning (Anggareni & Hidayat, 2019; Gomez, 2007). Of course, the learning planning must pay attention to the needs of students in order to make it easier for students to learn (Nasution, 2007). Giving freedom to students to take advantage of the potential that exists within them, it will happen extraordinary things that are unthinkable by an educator. Therefore, as educators, they should prepare learning that is able to explore the potential of students so that students' creative thinking is honed since school. In the end, students will get used to coming up with creative ideas in solving problems both related to learning and everyday life.

In addition, based on the results of further interviews with S1 and their parents, data was obtained that parents have an important role in learning differentiation. This opinion is in accordance with (Smutny, 2011). which states that in many ways, differentiated instruction (especially for children) begins at home. This is because, parents are the people who know best, know their strengths and weaknesses, their passions and interests, a lot of knowledge and insight about how, when, and why their children learn well and into situations or experiences that tend to lead to negative outcomes, confidence or disappointment, fear or determination, fear or excitement (Smutny, 2011). The development of the potential of students cannot be separated from the intervention of parents. This is in accordance with the core of the Kurikulum Merdeka. The Ministry of Education and Culture stated the need for synergistic collaboration between educational programs carried out with the family environment (Wahdani, 2020). In this case, the guideline is the Tri Center of Education initiated by Ki Hajar Dewantara, which demands the harmony of education in education units, families, and communities (Mustaghfiroh, S., 2020).

4. CONCLUSION

Based on the results and discussion, there are several conclusions. First, subjects in each category tend to be able to show aspects of flexibility, but only subjects in high categories tend to show aspects of novelty (novelty). Second, there is one low category subject who is able to show aspects of novelty (novelty), even though it is a simple thing, but if creative thinking is honed through differentiated instruction, the learning carried out might increase achievement and develop students' creative thinking. Third, giving freedom to students in utilizing the potential that exists within themselves, it will increase student creativity. Fourth, as educators, they should prepare learning that is able to explore the potential of students so that students' creative thinking is honed since school. In the end, students will get used to coming up with creative ideas in solving problems both related to learning and everyday life. Fifth, synergistic cooperation is needed between the education unit and the family environment to implement differentiated instruction which is the core of an free curriculum (Kurikulum Merdeka). Some suggestions that researchers can do are, first, CCST should give students more freedom to explore students' understanding of Cartesian Coordinates without limiting individual or group tasks, many objects to be achieved, or ways of presenting data according to students' understanding. Second, this CCST was done online, so that the scaffolding provided was not optimal because it was only through the WhatsApp application or zoom meeting, students should be guided directly to see their progress in working on the CCST. Third, provide learning that provides opportunities for students to demonstrate their understanding in a way that is unique and appropriate to the characteristics of students, not only about cartesian coordinate but also other material.

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AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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