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The influence of PjBL based on 21CLD self-regulation dimension using google sites to creativity and self-regulation

Rima Ahadiah[1], Aa Juhanda[1], Hendrawati[2], Gina Nuranti[1*]
[1]Biology Education, Faculty of Teacher Training and Education, Muhammadiyah University of Sukabumi, Jl. R. Syamsudin, S.H. No. 50 Sukabumi, West Java, Indonesia
[2]SMAN 2 Kota Sukabumi, Jl. Karamat No. 93 Sukabumi, West Java, Indonesia
[*]Corresponding author: ginanuranti@ummi.ac.id

ABSTRACT

This study was motivated by the low self-regulation of students and the lack of creativity training in the form of ICT in biology learning. This study aims to determine the effect of PjBL based on 21CLD self-regulation dimension using Google Sites on creativity and self-regulation of high school students on excretory system material. The research method used was Quasi Experiment with Post Test Only Non-Equivalent Control Group Design. The research samples were XI D class as the experimental class and XI I as the control class. The instruments used are product assessment sheets, questionnaires, and observation sheets. The research results showed that student creativity in the experimental class on excretory system material obtained an average value of 84.8 and self-regulation of 86.6, with an excellent category. The results of the hypothesis test obtained a significance value of 0.001 on creativity data and 0.002 on self-regulation data (p <0.05). The result of the correlation test obtained a significance value of 0.001 <0.05 with a Pearson Correlation value of 0.539, which indicates the level of relationship is included in the medium category. From this study, it was concluded that PjBL based on 21CLD self-regulation dimension using Google Sites, had an effect on creativity and self-regulation of high school students in the excretory system material. The finding in this study is that the PjBL model based on 21CLD self-regulation dimension is much better for practicing self-regulation compared to creativity.

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Creativity, *Google Sites*, PjBL, Self-Regulation, 21CLD

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INTRODUCTION

The world has now entered the era of *Society* 5.0, which is defined as an era of society that uses technology to improve the quality of human life (Rouf, 2019). In the era of society 5.0, the skills competencies needed are 21st century skills (Harun, 2020), one of which is creativity. Creativity is a process to generate new ideas or new products that are original (Hasanah et al., 2023). To stimulating creativity, it can use ICT (Tanwir et al., 2018). The use of ICT can increase creativity (Sadiah et al., 2021).

In order for students to have good creativity, they must also have good self-regulation. Self-regulation is needed to support creativity because it can help individuals to focus attention on the product they are working on, manage emotions so that they do not inhibit their creative process and

overcome obstacles in finding ideas or solutions so that they can produce something new and original. Therefore, it is important to develop self-regulation to support creativity. But unfortunately, several studies show that self-regulation and student creativity in Indonesia currently still tend to be relatively low, this is evidenced in the research of Friskilia & Winata (2018), Nuraini et al., (2017), Dina (2023) and Zuhriyah et al., (2022). It can be seen that there no effort from students to show willingness to organize learning patterns (Nuraini et al., 2017). The low level of creativity is partly due to the lack of learning media (Zuhriyah et al., 2022).

According to the results of preliminary observations conducted at one of the high schools in Sukabumi City obtained through interviews with one of the biology teachers, it was found that creativity in the form of ICT had not been trained, creativity was assessed only in the form of practicum reports, if there were products in the form of power points made in Microsoft Power Point or Canva which were commonly used, even though the technology at school was adequate but had not been maximally utilized.

Therefore, to overcome these problems, namely by using student-centered, experiment-based, and constructive learning models, one of which is by using PjBL (Project Based Learning) (Harun, 2020; Santyasa et al., 2020). PjBL plays an important role in the learning process, especially in the 21st century (Rafik et.al., 2022). PjBL has an influence on student creativity (Fitri et al., 2021; Solehah & Carolina, 2023; Dinantika et al., 2019). This is possible because PjBL focuses on student learning towards their learning creativity, students are encouraged to be more skilled and creative in designing and creating a project (Fitri et al., 2021). Meanwhile, according to Riak (2023), the results of his research show that the use of the PjBL model can improve self-regulation skills. PjBL has an impact on students' ability to manage time, develop work plans in project completion, and be able to conduct evaluation and self-reflection.

21st Century Learning Design (21CLD) is a learning design to develop 21st century skills using digital technology. This learning design will enable students to develop the skills they need to live and work in a globally connected 21st century world. 21CLD consists of six dimensions or 21st century skills that are recognized by researchers as important aspects in the current context, but this study uses the self-regulation dimension of 21CLD because self-regulation is very important for students' future success in the workplace. Therefore, students should be able to develop self-regulation skills by designing appropriate learning tasks (Microsoft, 2023).

PjBL based on the 21CLD self-regulation dimension is very possible to use in this learning because PjBL provides opportunities for students to plan, manage, and complete projects independently. This is also in accordance with level 4 of the 21CLD self-regulation dimension rubric according to Microsoft (2023), where level 4 of this rubric is the most complex level, namely long-term learning activities; and students have learning goals and associated success criteria before completing their work; and students have the opportunity to plan their own work; and students have the opportunity to revise their work based on feedback (Microsoft, 2023).

One of the digital technologies that can be used as a project to train creativity and self-regulation in PjBL based on the 21CLD self-regulation dimension is Google Sites. Google Sites is one of Google's service that functions to create an attractive and easy-to-use website so that students can be creative in designing and creating learning websites according to their own creativity (Novita &

Hermanto, 2021). Google Sites has the advantage that it does not require users to download applications, so it does not cause waste of user quota and storage (Sapulete et al., 2023).

The purpose of this study is to determine the effect of PjBL based on 21CLD self-regulation dimension using Google Sites to creativity and self-regulation of high school students on excretory system material. This research is expected to provide an overview of the influence of PjBL based on 21CLD self-regulation dimension using Google Sites on student creativity and self-regulation and provide solutions for biology / IPA teachers in Indonesia in equipping creativity and self-regulation in students. This research can also be used as a reference for learning media that can be used to train students' creativity and self-regulation.

METHOD

This type of research is quantitative research with a quasi-experiment method. The design of this study uses Post-test Only Non-equivalent Control Group Design, where there are two groups that are not randomly selected, namely the experimental group and the control group. The experimental class is a class that is given learning treatment using PjBL based on 21CLD self-regulation dimension using Google Sites with a project to create a website created using Google Sites, while the control group is given a conventional learning treatment, namely the Discovery Learning model with a project to create a poster using the Canva application. The 21CLD self-regulation dimension rubric used in this study is level 4, which is the most complex level and is in accordance with PjBL learning activities. This can be seen in from the following decision tree modified from the 21CLD self-regulation dimension rubric developed by Microsoft (2023).

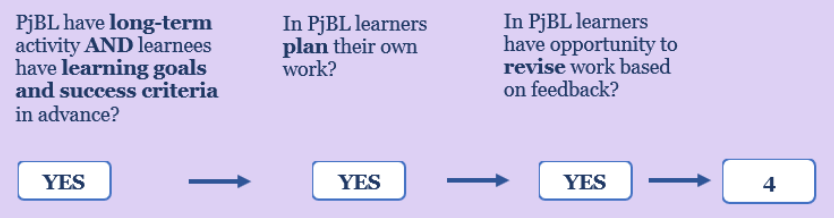

Figure 1. PjBL *decision tree* on 21CLD self-regulation dimension.
(Modification from Microsoft, 2023)

This research was conducted at SMAN 2 Kota Sukabumi located at Jl. Karamat No. 93, Kec. Gunungpuyuh, Sukabumi city in May 2024 for 3 weeks. The population in this study were even semester grade XI students of SMAN 2 Kota Sukabumi for the 2023/2024 academic year. In this study, the samples selected were two classes, namely class XI D as the experimental class and class XI I as the control class selected based on purposive sampling, each class consisting of 32 students. The material used in this study was excretory system material.

The instruments used as data collection tools in this study consisted of: 1) Product assessment sheet to measure creativity consisting of 10 aspects of assessment referring to the Creativity Product Analysis Matrix (CPAM) developed by Besemer and Treffinger (1981) which consists of 3 indicators, namely a) novelty with germinal and original criteria; b) resolution with logical, useful and valuable criteria; and c) elaboration & synthesis with complex, elegant, expressive and well-crafted criteria. Product assessment is scored on a scale of 1 to 4 for each aspect. 2) Self-regulation questionnaire consisting of 30 statement items (positive and negative each consisting of 15 statements) referring to

3 indicators of self-regulation according to Zimmerman and Schunk (2004) in Kusaeri & Mulhamah (2016), namely a) metacognition consisting of 5 sub-indicators namely planning, organizing, self-instructing, monitoring and evaluating; b) motivation which consists of 3 sub-indicators namely self-actualization, self-confidence and independence; and c) behavior which consists of 2 sub-indicators namely selecting and arranging & oranizing the environment using Likert scale according to Sugiyono (2018). 3) Questionnaire of student responses to the PjBL model based on 21CLD self-regulation dimension using Google Sites consisting of 16 questions using the Guttman scale. 4) Observation sheet for learning implementation using the Guttman scale. Before being used in research, the instrument was tested for validity first. In this study, a validity test was used through expert opinion (judgment experts).

The score data obtained is then summed up and percented. The percentage obtained is then categorized based on the assessment category according to Sugiyono (2018), which can be seen in the following Table 1.

Table 1. Category interpretation

No	Percentage	Category
1	81% - 100%	Excellent
2	61% - 80%	Good
3	41% – 60%	Pretty Good
4	21% - 40%	Not Good
5	0% - 20%	Very Bad

(Sugiyono, 2018)

The data analysis technique was carried out statistically using the SPSS 29.0 application, namely the parametric analysis prerequisite test (normality and homogeneity test), hypothesis test analyzed using the t test (independent t test) and correlation test using Pearson correlation to determine the relationship between two variables.

RESULTS AND DISCUSSION

The Influence of PjBL Based on 21CLD Self-Regulation Dimension Using *Google Sites* to Creativity and Self-Regulation of High School Students on Excretory System Materials

Assessment of student creativity and self-regulation is taken based on the results of product assessment and self-regulation questionnaire. The results of the data were taken on average from each class and then compared. The following is a comparison of the average value of creativity and self-regulation of students in the experimental class and the control class in Table 2.

Table 2. Comparison of average scores of student creativity and self-regulation in the experimental class and control class.

Variables	Class	Average Value (%)	Category
Creativity	Experiment	84,8	Excellent
	Control	78,4	Good
Self-Regulation	Experiment	86,6	Excellent
	Control	79,3	Good

Based on Table 2, the average value of creativity in the experimental class is higher than the control class with a difference of 6.4%, as well as the average value of self-regulation with a difference of 7.3%. Based on the calculation results of the two classes, parametric analysis prerequisite tests and

hypothesis tests were then carried out. The recapitulation results of the analysis are presented in Table 3 below.

Table 3. Recapitulation of normality test, homogeneity test and hypothesis test

Testing	Class	Description	Score (Sig.)	Description
Normality Test (Shapiro-Wilk)	Experiment	Creativity	0,102	Normally Distributed Data
		Self-Regulation	0,132	
	Control	Creativity	0,074	
		Self-Regulation	0,645	
Homogeneity Test (Levene Test)	Creativity Experiment Control	*Based on Mean*	0,294	Homogeneously Distributed Data
	Self-Regulation Experiment Control	*Based on Mean*	0,069	
Hypothesis Test (Independent Sample T-test)	Creativity	*Equal variances assumed*	0,001	Significantly Different
	Self-Regulation	*Equal variances assumed*	0,002	

The results of the normality test and homogeneity test show that creativity and self-regulation data are normally distributed and homogeneous because the sig.>0.05 results. Hypothesis testing using an independent sample t-test shows that creativity data has a significance value of sig. (2-tailed) 0.001 and self-regulation data 0.002 which indicates that the data is significantly different ($p<0.05$), so it can be seen that both data show the hypothesis H0 is rejected and H1 is accepted. Therefore, it can be concluded that the use of the PjBL model based on the 21CLD self-regulation dimension using Google Sites influence on creativity and self-regulation of high school students in the excretory system material. This good result is also supported by positive student responses, this is shown in the following Table 4.

Table 4. Student response result

No	Indicator	Average Value (%)	Category
1	Students' learning interest in the PjBL model based on 21CLD self-regulation dimension using *Google Sites*	91,4	Excellent
2	The relationship of PjBL model based on 21CLD self-regulation dimension using *Google Sites* with Creativity	90,6	Excellent
3	The relationship of PjBL model based on 21CLD self-regulation dimension using *Google Sites* with self-regulation	92,2	Excellent
4	The Relationship of PjBL model based on 21CLD self-regulation dimension using *Google Sites* with Excretory System Materials	88,3	Excellent

Based on Table 4, it is known that student responses to all indicators are categorized is excellent. Overall, the final score of the student response questionnaire was obtained at 90.6%, so it can be seen that students responded positively to the application of the PjBL model based on 21CLD self-regulation dimension using *Google Sites*. In addition, the results of observations of learning implementation also show good results, this can be seen from the average value of the percentage of learning implementation obtained at 100% with excellent categories presented in the following table.

Table 5. Observation results of learning implementation

No	Class - Model	Average Implementation Score (%)	Category
1	Experiment – PjBL Based on 21CLD Self-Regulation Dimension	100%	Excellent
2	Control – Discovery Learning	100%	Excellent

The results obtained from all the data processing above show that learning using the PjBL model based on 21CLD self-regulation dimension using Google Sites in the experimental class has an

influence on student creativity and self-regulation. This is in accordance with Burksaitiene (2014) research that project-based learning improves students' self-regulation and creativity. The creativity and self-regulation of students in the experimental class are superior to the control class because learning using the PjBL model is student-centered (Setiawan et al., 2023; Anh & Truong, 2023) which includes working on projects to solve a problem, through this project can encourage creativity. In this study, the PjBL model was designed with 21st century learning design (21CLD) level 4 self-regulation dimension so that all students play an active role in managing their own learning (Microsoft, 2023) and this is in line with Shin (2018) that PjBL makes students play an active role, construct knowledge and reflect on their own learning projects, thereby improving self-regulation. In addition, the project in this study was made in the form of ICT so that creating a more interesting learning experien ce for students compared to commonly used projects. This is in line with the results of Haryanto & Rochsantiningsih (2016) which proved that PjBL with ICT can bring positive benefits due to students' confidence in technology.

Student Creativity on Each Indicator in the Experimental Class and in the Control Class

Student creativity is known through the results of product assessment analysis based on the CPAM rubric. The following are the results of student creativity on each indicator in Figure 2 below.

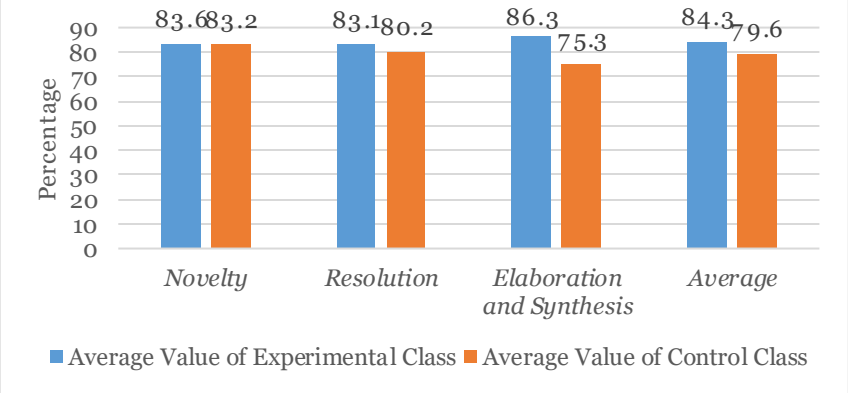

Figure 2. Student creativity diagram on each indicator.

Based on Figure 2, the overall calculation results show the final score of the creativity product assessment in the experimental class with the excellent category, while in the control class with the good category. The data shows that student creativity in the experimental class is superior to the control class, the creativity of experimental class students shows an average value in the excellent category in all indicators. This is because in the experimental class, researchers used the PjBL model based on 21CLD self-regulation dimension assisted by Google Sites with a project to create websites. These results are in line with the research of Pujiriyanto & Mulyoto (2016) that PjBL is more effective than traditional teaching strategies in fostering creativity. Condliffe et al., (2017), Usmeldi (2019) and Sakbana et al., (2021) also stated that PjBL can be used to increase creativity. In addition, the data above also shows a difference in the average value on each creativity indicator in both the experimental and control classes, this is because each student has their own creativity, so there are differences in each indicator.

The first indicator is novelty, consists of two criteria, namely germinal and original. Novelty concerns the originality of the concept underlying a product (Tsai, 2016). The average results show

that the difference between the two classes is not much different, only 0.4. This is because the experimental class is using Google sites, where students have just been trained to create websites so there are still some websites created by students using the same format as the website exemplified by the teacher. While the control class made posters using the Canva application where many templates were already available (Faqe Abdulla, 2024; Pedroso et al., 2023; Candra et al., 2022) so that students can easily create posters that are different from the format that has been exemplified by the teacher. Although not much different, the experimental class was still superior to the control class. This provides information that in this indicator, the experimental class can already create a website with new ideas that can inspire others. Students also create websites using new concepts and formats that are different from the websites modeled by the teacher before. This supports the statement by Besemer & Susan (2000) that novelty includes consideration of new concepts and according to Hanif et al., (2019) original is how the product differs from existing ones.

The second indicator is resolution, consists of three criteria, namely logical, useful and valuable. Resolution is how well the product meets a needs or works to solve problems (Nurmaliah et al., 2020). The result of the average value show that the difference between the two classes is not much different, only 2.9. This is because in the early stages of learning both using the PjBL model based on the 21CLD self-regulation dimension and discovery learning both provide free opportunities for students to investigate and identify problems that have been outlined in the LKPD. This is in accordance with Munandar in Hanif et al., (2019) which state that creativity can be developed in a free situation to conduct investigations. Furthermore, to solve these problems both in PjBL based on the 21CLD self-regulation dimension and discovery learning, students are given the opportunity to collect the necessary data. Through this data collection process, students have a great opportunity to understand the lesson more thoroughly and apply it in real life situations (THY Pham et al., 2023). In the next step of PjBL, students are guided to design product plan while in discovery learning this step does not exist. Therefore it is very reasonable that the experimental class has a higher score than the control class, even though the difference is not too far away because this step helps students focus more on making products according to the design that has been made, this is in accordance with the explanation of Besemer (1999) and Donald (1981) that products are made based on certain rules.

The third indicator is elaboration & synthesis, which consists of four criteria, namely complex, elegant, expressive and well-crafted. Besemer in Nurmaliah et al., (2020) explains elaboration and synthesis is the extents to which a product combines different elements into a single unit. Based on the results of the average value, it shows that students in the experimental class are superior to the control class with a difference of 11.0. This is due to the influence of the PjBL model based on 21CLD self-regulation dimension using Google Sites applied in the experimental class because there is a stage that facilitates students to revise their products while in discovery learning there is no, so it is very reasonable that the experimental class value is higher than the control class. With the self-regulation dimension of 21CLD, students are given feedback and the opportunity to revise their products, this becomes a reflection for students to make improvements (Azhary et al., 2021) and find the best way to improve the quality of the product so that in this case students have tried their best to combine various elements (text, images, videos, supporting elements) so that a website is produced with a combination of all elements that are harmonious, become a single unit and are well arranged, this is

in accordance with what Tsai (2016) stated that elaboration & synthesis is related to the aesthetic perspective. In addition, with the help of Google Sites, students can not only insert text and images, but can also insert videos (Napitu et al., 2023; Mulyaningsih et al., 2023; Mukti et al., 2020) so that it is more detailed than posters which are limited in inserting videos.

From the explanation above, although the overall final score is significantly different, the difference in indicators is not too far, only the elaboration & synthesis indicator is significantly different, so it can be concluded that in addition to using the PjBL model based on 21CLD self-regulation dimension, the Discovery Learning model can also train creativity. This is in accordance with the results of research by Muizzah & Fatkhiyani, (2023); Kanna et al., (2018); Suryanto et al., (2022).

Student Self-Regulation on Each Indicator in the Experimental Class and in the Control Class

Student self-regulation is known through the results of the self-regulation questionnaires analysis. The following are the results of student self-regulation on each indicator in Figure 3 below.

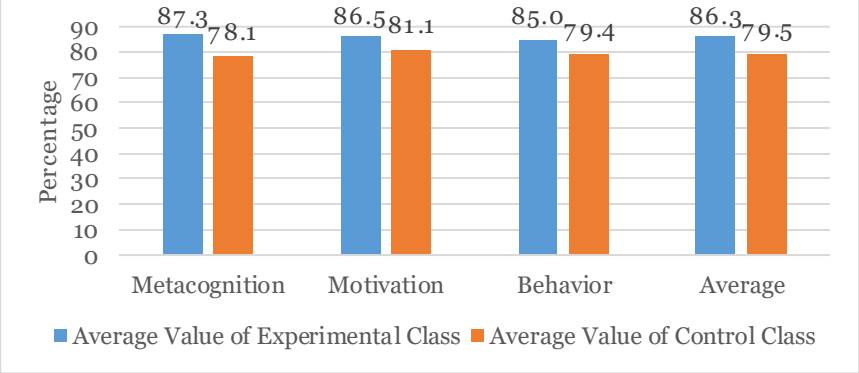

Figure 3. Student self-regulation diagram on each indicator.

Based on Figure 3, the overall calculation results show the final score of the self-regulation questionnaire in the experimental class with the excellent category, while in the control class with the good category. The data shows that student self-regulation in the experimental class is superior to the control class, the experimental class students' self-regulation shows an average value in the excellent category in all indicators. This is because in the experimental class, researchers used a PjBL model designed using 21st century learning design (21CLD) self-regulation dimension developed by Microsoft 2023. Using PjBL based on 21CLD self-regulation dimension provides opportunities for students to plan, organize, monitor, evaluate, and ultimately control their own learning so that students are actively involved in learning activities. This is in line with Bandura (1986) that self-regulation occurs when learners play an active role in the learning process and control it effectively to achieve the desired goals. In addition, Foster & Shriner (2023) and Susilowaty (2020) stated that PjBL improves self-regulation. Based on the data above, it also shows that there are differences in the average value of each indicator of self-regulation in both experimental and control classes, this is because each student has their own self-regulation, so there are differences in each indicator.

The first indicator, metacognition consists of five sub-indicators, namely planning, organizing, self-instruction, monitoring and evaluating. Based on the average value, it shows that students in the

experimental class are far superior to the control class with a difference of 9.2, which means that in this indicator the experimental class can control their own learning so that they can complete the website creation project well. This is due to the influence of the PjBL model based on 21CLD self-regulation dimension using Google Sites which is applied in the experimental class. In the PjBL Design a Plan for the Project step, students plan and design their own work with teacher guidance. Next, in the PjBL Create a Schedule step, students make decisions about the schedule and steps they will follow to complete the project. Then, before assessing the results of the products that have been made, in the PjBL Monitor the Students and the Progress of the Project step, students are guided to make their own goals and success criteria before completing their work and in the PjBl Assess the Outcome step, students are given feedback on the products they have made and students are given the opportunity to revise their products based on the feedback received and their own deliberate self-reflection process. Meanwhile on *discovery learning* does not have these steps, so it is very reasonable that the experimental class scores are higher than the control class. This is in accordance with Novarianing Asri et al., (2017) which states that students who have self-regulation in learning are able to set goals, plan, and use effective learning strategies.

The second indicator is motivation, consisting of three sub-indicators namely self-actualization, self-confidence and independence. Based on the average value, it shows that students in the experimental class are superior to the control class with a difference of 5.4, which means that students in the experimental class have better motivation to complete website products than the control class. This is due to the influence of the PjBL model based on 21CLD self-regulation dimension using Google Sites which is applied in the experimental class because there is a stage that facilitates students to create their own designs, goals and success criteria for each then give feedback, while discovery learning does not exist because this is a driving force for students so that they feel that they are competent, have confidence and have independence in completing the product independently according to their goals without relying on others. This is in line with Susilowaty (2020) that students who have high motivation in learning, are able to organize and place themselves to achieve their learning goals, and students who have high self-regulation will be able to complete their learning tasks independently. According to Yolanda et al., (2021) self-confidence has a positive impact on various aspects of life, especially in the aspect of education.

The third indicator is behavior, which consists of two sub-indicators, namely selecting and arranging & organizing the environment. The average score results show that students in the experimental class are far superior with a difference of 5.6. This is due to the influence of the PjBL model based on 21CLD self-regulation dimensions using Google Sites applied in the experimental class. By using the PjBL model based on 21CLD self-regulation dimension, there is a stage where the teacher monitors the development of products made by students so that students are given direction and reminded to select information sources, images and videos that are in accordance with the learning outcomes. Behavior is an attitude that shows enthusiasm and responsibility (Rizki, 2021) including in terms of selecting information sources. Widiastuty et al., (2022) explained that a person must be able to regulate their own behavior in order to achieve the desired goals.

From the explanation above, it can be concluded that the PjBL model based on 21CLD self-regulation dimension is very good for training student self-regulation.

The Relationship between Student Creativity and Self-Regulation

To find whether there is a reciprocal relationship between the two variables, a correlation test was conducted. The results of the correlation test are presented in the following Table 6 below.

Tabel 6. Correlation Test Result

		Creativity	Self-Regulation	Description
Creativity	*Person Correlation*	1	0,539**	Medium Correlation
	Sig. (2-tailed)		0,001	Correlated
	N	32	32	-
Self-Regulation	*Person Correlation*	0,539**	1	
	Sig. (2-tailed)	0,001		
	N	32	32	

Based on Table 6, the value of Sig. (2-tailed) <0.05, which means it shows that there is a relationship between the two variables. Furthermore, the Pearson Correlation value shows the level of relationship between the two variables is included in the medium category. The two variables have a positive relationship where the direction of motion of the two variables is the same. This is in accordance with Al-Kreimeen (2014) research which shows that there is a significant positive correlation between creativity and student self-regulation. This positive relationship means that when student creativity increases, there will also be an increase in self-regulation. Conversely, when students' self-regulation is high, their creativity is also high.

According to Al-Kreimeen (2014), in order for creativity efforts to be made, individuals must use the self-regulation function to monitor, evaluate, and take strategic action on their behavior. Through developing self-regulation, individuals can increase their creativity and produce something new and original. In addition, according to Zielińska, A., et.al. (2022), adolescents who develop creativity projects by self-regulating make their activities more effective.

CONCLUSION

Based on the results of the research and data analysis that has been carried out, it is concluded that there is an influence of the PjBL model based on 21CLD self-regulation dimension using Google Sites on the creativity and self-regulation of high school students on the excretory system material. The results showed that the creativity and self-regulation of students in the experimental class resulted in an average score in the excellent category, while in the control class obtained an average score in the good category. The correlation test results show that there is a relationship between creativity and self-regulation with the level of relationship between the two variables included in the medium category. The finding in this study is that the PjBL model based on 21CLD self-regulation dimension is much better for practicing self-regulation than creativity.

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