DIJEMSS:
Dinasti International Journal of Education Management and Social Science
E-ISSN: 2686-6331
P-ISSN: 2686-6358
https://dinastipub.org/DIJEMSS dinasti.info@gmail.com +62 811 7404 455
DINASTI PUBLISHER

DOI: https://doi.org/10.38035/dijemss.v6i1
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Received: 23 October 2024 | **Revised:** 25 October 2024 | **Publish:** 25 October 2024

The Role of Knowledge Management in Managing Students' Creative Thinking Skills Using the Project Based Learning Model in the Era of Industrial Revolution 4.0

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Abstract: This research aims to determine the effectiveness of implementing the Project Based Learning Model in improving creative thinking skills in Cirebon Regency High Schools and the differences between each school. The method used in this research is research and development or "Research and Development " (R&D) using the Borg & Gall development research model with a quantitative approach. The population in this study were 5 high schools with 2 schools where testing was limited and 3 schools where testing was large. A total of 316 students were selected as samples using the purposive random sampling method in the experimental class and control class. Questionnaires are used to collect data. The validity of the instrument was confirmed using exploratory factor analysis, while reliability was estimated using Cronbach Alpha. Data were analyzed statistically with SPSS 21 using quantitative descriptive and Analysis of Variance (ANOVA). The research results show that the effectiveness of implementing the Project Based Learning Model is in the "very good" category, and there is no significant difference in the level of creative thinking abilities. The research results show that each school shows the same results in improving creative thinking skills with the appropriate level of effectiveness. Based on the research results, it is recommended to use the Project Based Learning Model for creative thinking skills for deeper learning in the future with the different characteristics of each school.

Keyword: Project Based Learning, Creative Thinking, Industrial Revolution Era 4.0

INTRODUCTION

The world of education experienced very difficult challenges and trials in 2020, due to the Covid19 pandemic. From this outbreak we take lessons to evaluate and change our educational paradigm, especially in the learning process, namely from traditional methods to technological methods or what we call the era of industrial revolution 4.0. The ability to think creatively is very necessary so that the competence of our human resources is not inferior to other nations. As is known, the basic foundations of thinking have generally not been mastered well by students. Several research results show the low thinking abilities of high school students, undergraduate students, and even master's students (Rofi'uddin , 2009).

The development of the times entering the Industrial Revolution 4.0 which relies on *cyber-physical systems* invites education and culture actors to adapt to these developments. School reform, increasing teacher capacity and professionalism, a dynamic curriculum, reliable facilities and infrastructure, and superior learning technology are a necessity in our education. Speed and accuracy are the keys to facing these changes. However, the management of imaginative learning actions will occur productively and successfully in the department The factor is the educator's skills in being competent in educational administration through progress by doing it seriously settings, and hands-on experiences that will encourage sharing and further development of people and groups of students level of information (Chantarasombat, 2007). It is important to further develop the improvement of educators by empowering them increasing the ability to obtain board actions and imaginative

reasoning regarding learning plans appropriate practice for students. Many researchers (Kersensteiners, 1925; Hibnere, 1998; Lubart and Georgsdottir, 2004) noted that the tremendous impact caused by refreshing and fostering students' creativity can be implemented through the character of a teacher and educational nature.

A study conducted by Ucus (2017) shows that educators are very active in supporting students' creative reasoning abilities in the classroom. According to Nami , Marsooli , and Ashouri (2014), students' creative reasoning abilities basically have a definite relationship with student achievement. Eishani , Saa'd , and Nami (2014) determined that students' innovative reasoning abilities are all related to students' learning styles in terms of emotional experiences, conceptual ideas, dynamic experiments, and intelligent perception. It didn't last long before there were still detailed explanations regarding the characteristics of students' creative reasoning abilities in previous studies. Gantasala and Gantasala (2009) found that visual, auditory and sensation learning styles, as the three recipients of touch, are aspects of student learning styles. Alkathiri , Alshreef , Alajmi , Alsowayan , and Alah -mad (2018); Polat , Peker , Ozpeynirci , and Duman (2015); Niculescu , and Usaci (2015); Magdalene (2015); Rezaeinejad , Azizifar , and Gowhary (2015); Yee, Yunos , Othman, Hassan, Tee, Mohamad (2015); Omar, Mohammad, Paimin , (2015); In addition, Gogus and Ertek (2016) introduced that student learning styles are associated with student achievement. According to Pasina , Bayram , Labib , Abdelhadi , and Nurunnabi (2019), students' learning style tendencies can be the reason why students gather in class to do assignments. Yazicilar , and Guven (2009); Additionally, Maric , Penger , Todorovic , Djurica , and Pintar (2015) underscored that the educational experience in the classroom is more engaging by considering students' learning styles. Information, abilities and capabilities are expected to be conveyed by demonstrating techniques and methodologies that suit students' learning styles. Teachers must know students' learning styles and implementation of teaching methods to truly guarantee learning exchange. However, there are still few reviews that discuss student learning style models carried out in elementary schools. Educators must be aware of students' learning styles and applied pedagogy to ensure effective transfer of learning. However, there is still little research discussing student learning style models applied in elementary schools . Research conducted by Alkathiri , Alshreef , Alajmi , Alsowayan , & Alah -mad (2018); Kassim (2013); and Eishani , Saa'd , & Nami (2014) found that student learning styles predicted students' creative thinking abilities. This research states that accommodating learning material design to student learning styles can improve student understanding. By paying attention to students' learning styles, especially information processing, students can deal with the representation of information in learning materials so that they can improve their creative thinking abilities. However, further confirmation is needed regarding the relationship between dimensions of student learning styles and students' creative thinking skills, environmental management and the creation of creative thinking skills need to be a priority. Creativity does not occur in a vacuum, it is based on knowledge. However, what schools should at least focus on is teaching and practicing how existing knowledge can be used to produce creative ideas and problem solutions. In schools that focus on creativity, it is often seen that the development of creativity is embedded in arts subjects, but not in subjects such as writing and mathematics (Wyse, 2015). Cotter, Pretz and Kaufman (2016) studied the relationship between college applicants' creativity, extracurricular involvement and traditional admissions criteria (e.g., SAT scores, high school rank). The results showed that applicants' extracurricular activities positively predicted their creativity, whereas academic performance or traditional admissions criteria even showed a negative relationship with creativity.

Apart from that, students' creative thinking abilities in Indonesia are still low, as can be seen from the results of creativity indicators, namely from The Global Creativity Index (GCI: 2015). Indonesia's ranking data in the survey was ranked 115th out of 139 countries with 67 technology acquisition, talent (108), tolerance. (115) and the average Global Creativity Index (0.202). The author concludes that Indonesia is still in the low category in terms of creativity. Therefore, it is necessary to transform education in any subject, from learning by memorizing to learning to thinking, or from shallow learning to deep or complex learning (Suastra , 2008). Students must be sure that the subjects they study are interesting and useful, because they can help them understand the world and themselves. The learning process must be biased towards increasing imagination, creativity and logical thinking abilities.

Think creatively; E. Paul Torrance wrote, " creative and intuitive thought processes represent the highest human thinking abilities" (Torrance and Safter , 1990, p. 7). His work began with this premise and, over more than six decades, he discovered quantitative and experiential evidence of its validity. In 2002, Bloom's Taxonomy went beyond Torrance's thinking and was revised, placing creativity as the most complex cognitive process (Krathwohl , 2002). Creative learning is a teaching and learning paradigm that requires students' creative thinking abilities in studying core academic subjects. Torrance (1979), in his work developing the Teaching Incubation Model, identified 18 creative thinking skills that underlie creativity. The following list is a simple summary of these skills: imagine, experiment, discover, outline, test solutions, and communicate findings. Although Torrance highlighted these dimensions of learning in the 1970s, you will recognize them as the foundation of what we now call 21st century skills: creativity, critical thinking, problem solving, communication, and collaboration (Partnership for 21st Century Skills, 2015). According to Young & Balli (in Bergili , 2015, p. 2) creative thinking can be interpreted as a whole series of cognitive activities used by individuals in dealing with problems from a condition so that they try to use imagination, intelligence, insight. and ideas when they encounter the situation or

problem of the problem. Creative thinking is a series of processes for understanding problems, making guesses, making hypotheses about problems, looking for answers, proposing evidence, and finally reporting results to be applied in the creation process.

Creativity is important for innovation (Scot, 2004), everyday problem solving (Runco , 2004) , as well as emotional health and well-being . It is known that the need for people who are able to think creatively exceeds the level of availability of creativity. Academics, business leaders, and policymakers around the world have emphasized that creativity must be fostered throughout society. Although creativity can be fostered, in most educational settings, little attention is paid to developing students' creative thinking skills. There is a strong need for well-developed, non-domain-specific, scientifically tested creativity training that can be easily implemented in educational settings.

Furthermore, in the learning process according to (Joyce, 1992, 4) a Learning Model is a plan or pattern that is used as a guide in planning learning in class or learning in tutorials and for determining learning tools including books, films, computers, curriculum, etc. . Joyce further stated that each learning model directs us to design learning to help students in such a way that learning objectives are achieved. Trianto (2014:24) from Soekamto , et al. (in Nurulwati , 2000: 10) states that a learning model is: "A conceptual framework that describes systematic procedures in organizing learning experiences to achieve certain learning goals, and functions as a guide for learning designers and teachers in planning teaching and learning activities. " Arends (1997: 7) further states " *The term teaching model refers to a specific approach to teaching that includes objectives, syntax, environment and management systems."* The term teaching model refers to a particular learning approach including its objectives, syntax , environment, and management system. From the description above with the problems and literature about the low ability to think creatively, it is necessary to take action to solve this problem. The efforts made in this research are by conducting research and developing learning models, namely improving creative thinking abilities.

METHOD

The method used in this research is research and development or " *Research and Development* " (R&D) with a quantitative approach. The use of methods (R and D), and this research approach is a quantitative approach because this research aims to develop a learning model. According to Borg and Gall (1989:783), " *Educational Research and Development* (R and D) *is the process used to develop and validate educational products"* . What is meant by product in the context of research and development according to Borg and Gall (1989) is not limited to material such as textbooks, educational films and other types, but also relates to procedures and processes such as learning methods and teaching methods. organizing learning.

Table 2 Criteria for Differentiating Power

Differentiating Strength	Criteria
> 0.40	Very good
0.30 – 0.39	Good
0.20 – 0.29	Enough
< 0.19	Bad

(Arifin , 2012)

Table 3. Item Validity Criteria

Score Range	Criteria
0.00 – 0.20	Bad / Ugly
0.21 – 0.29	Enough
0.30 – 0.39	Good
0.40 and above	Very good

(Sugiyono , 2013)

After the researcher carried out the instrument test, results were obtained based on statistical tests using SPSS 21, resulting in the following data:

Table 5
Research Sample Validity Results

Number	Pearson Correlation	Sign (0.05) r table	Information
1	,873* *	0.300	Legitimate
2	,823* *		Legitimate
3	,785* *		Legitimate

4	,785**	Legitimate
5	,836**	Legitimate
6	,431**	Legitimate
7	,873	Legitimate
8	,823**	Legitimate
9	,835**	Legitimate
10	,785**	Legitimate
11	,836**	Legitimate
12	,431**	Legitimate
13	,785**	Legitimate
14	,836**	Legitimate
15	,345**	Legitimate

Based on the results of the validity test, data was generated on test question number 1 with a Pearson Correlation of 0.873 with a Sig (2 tailed) of 0.000. The results showed that the Pearson correlation was > sig (0.05). For decision making, the results are concluded about the number numbers 1 through 15 are declared valid. Next, the researcher carried out a reliability test to determine whether the instrument was real or not. The results of the reliability test obtained the following data:

Table 6
Research Sample Reliability Test Results

Reliability Statistics	
Cronbach's Alpha	N Items
,944	15

To see whether the data is reliable or not, based on the Cronbach's Alpha test, data is declared reliable if the Cronbach's alpha value is greater than Sig (0.05). Judging from the data above, it turns out that Cronbach's Alpha has a value of 0.944 > Sig 0.05, meaning that all question items are reliable.

RESULTS AND DISCUSSION

The hypothesis in this research is the *Project Based Learning* Model effective in improving creative thinking abilities in the era of the industrial revolution 4. To answer this hypothesis the author carried out Oneway Anova test from research results. The tool for analyzing data is using SPSS 21.

Looking at the differences in average creative thinking in five high schools in Cirebon Regency

Table 7. Description of Creative Thinking

Descriptive

Think creatively

		N	Means	Std. Deviation	Std. Error	95% Confidence Interval for the Mean		Minimum	Maximum
						Lower limits	Upper limit		
Lemahabang School	High	31	88.16	5,610	1,008	86.10	90.22	71	96
Astanajapura School	High	30	86.90	4,788	,874	85.11	88.69	76	97
Karangwareng School	High	33	85.55	4,258	,741	84.04	87.06	74	95
Beber High School		32	86.13	4,301	,760	84.57	87.68	76	95
Middle Resources	School	32	85.41	4,039	,714	83.95	86.86	74	94
Entire		158	86.41	4,674	,372	85.67	87.14	71	97

Based on Table 1 of the SPSS 21 output above, you can see the differences in the average creative thinking of the five schools with the following details : SMAN Lemahabang 88.16, SMAN Astanajapura 86.90, SMAN Karangwareng 85.55, SMAN Beber 86.13, and SMAN Source 85.41. Thus, descriptively it can be concluded that the highest average of creative thinking is Lemahabang High School , namely 88.16.

Testing Similarity of Variants (Homogeneity)

Table 8 Homogeneity of Variance Test

Homogeneity of Variance Test			
Think creatively			
Levene Statistics	DF1	DF2	signatur e.
,736	4	153	,569

Based on Table 2, the SPSS 21 output above shows a Levene Statistical figure of 0.736 with a significance or probability (Sig) of 0.569. Because the significance value of 0.569 is greater than 0.05, it can be concluded that the five variants of schools of creative thinking that the author compares are the same or homogeneous.

Test whether the five samples have the same or different averages (Anova analysis)

ANOVA

Table 9 SPSS 21 ANOVA Creative Thinking Test

	Number of Boxes	Df	Mean Squared	F	signature.
Between Groups	161,782	4	40,445	1,893	,114
In Group	3268.294	153	21,361		
Entire	3430.076	157			

The basis for decision making in Anova Analysis is:

1. If the significance value (Sig) is > 0.05 then the average is the same
2. If the significance value (Sig) <0.05 then the averages are different

Based on table 3 of the Anova output above, it is known that the sig value is 0.114 > 0.05, so it can be concluded that the average creative thinking of the five schools is significantly the same.

Seeing the Average Similarity of Creative Thinking in Five Schools with the Project Based Learning Model

Table 5 Average of Creative Thinking School Limited Tests and Broad Tests

Think creatively		
Tukey HSD [a, b]		
Project Based Learning Model	N	Subset for alpha = 0.05
		1
Middle School Resources	32	85.41
Karangwareng High School	33	85.55
Beber High School	32	86.13
Astanajapura High School	30	86.90
Lemahabang High School	31	88.16
signature.		,130
Means for groups in homogeneous subsets are shown.		
A. Using a harmonic mean sample size = 31,567.		
B. Group sizes are not the same. The harmonic mean of the group sizes was used. The type I error rate is not guaranteed.		

To see the average similarity, the author will use the Tukey HSD output. The following is the interpretation of the table above: Based on table 5, in subset 1 there is data on Creative Thinking with the Project Based Learning Model, namely SMAN Sumber , SMAN Karangwareng , SMAN Beber , SMAN Astanajapura , and SMAN Lemahabang , meaning that the average is Creative Thinking in the five schools that use the Project Model. Based Learning does not have a significant difference. In other words, the average level of Creative Thinking at SMAN Sumber , SMAN Karangwareng , SMAN Beber , SMAN Astanajapura , and SMAN Lemahabang is the same.

Discussion

Based on the results of research conducted in five schools with limited and extensive trials, the following findings were obtained by teachers finding a new project-based learning model to be used in economics subjects.

The use of the Project Based Learning Model is a new learning model that can be used in economics and other materials. Utilization of technology that has not been maximized with the Project Based Learning Model must be used. Teachers feel more flexible in learning because the Project Based Learning Model really focuses on student teachers only as facilitators. With the Project Based Learning Model , students gain new experiences in the learning process Students feel that the Project Based Learning Model is a challenge because they have to think creatively in carrying out their assignments The Project Based Learning model requires students to improve their learning mentality because it is done together with individuals in carrying out tasks. The students are all active, there is no difference in the learning process by giving group assignments.

Whether a student's activities are accompanied by a teacher or not continues because the assignments are structured according to the sequence of assignment numbers that the students have received. The Project Based Learning model that utilizes technology is mandatory because it is a learning resource. If the teacher is not present with the Project Based Learning Model, students are required to report during the presentation and discussion in video form. The level of activity increases because the student's burden as a learner is aimed at being creative. The Project Based Learning model is appropriate to the era of industrial revolution 4.0 because the use of technology is important to include in learning. Schools no longer prohibit students from bringing cellphones to school because these devices are important in the Project Based Learning Model. Learning is not limited by space and time because technological devices are included in the Project Based Learning Model.

CONCLUSION

Based on the problem formulation and research objectives prepared, as well as the results of research and development, it can be concluded that the average of creative thinking at SMAN Sumber , SMAN Karangwareng , SMAN Beber , SMAN Astanajapura , and SMAN Lemahabang is the same. Thus, the Project Based Learning Model has a significant effect on the average difference in creative thinking at SMAN Sumber , SMAN Karangwareng , SMAN Beber , SMAN Astanajapura , and SMAN Lemahabang schools . Based on this research hypothesis, the Project Based Learning Model is Effective on Creative Thinking Abilities in the Industrial Revolution Era 4.0. Thus, this research hypothesis is accepted. Future generations need to think creatively in order to thrive in a rapidly changing world. This brings attention to the need to foster creativity. Education plays a central role in fostering creativity not only among the elite, but also in all students. Although the world has experienced revolutionary changes, teaching practices have not changed much: learning continues to focus primarily on rote learning, rather than stimulating creativity. The current findings demonstrate the effectiveness of a one-year training program in developing creative thinking skills in applied university students. The current findings suggest that by devoting curriculum time to creativity development, we can contribute to preparing students for a rapidly changing world after graduation. However, an enhanced creative thinking style did not necessarily result in more original ideas—participants' originality of ideas scores did not improve in the creativity training group, nor did the training group generate more creative ideas than the control condition. These findings indicate that creativity training must be further refined in order to provide optimal benefits for the development of students' creativity. Additionally, an important question for future research is to focus on the optimal duration of creativity training. The current training is a one -year creativity training course, and students' creative performance is measured before, midway through, and after the training. Importantly, although there were significant improvements in ideation skills and cognitive flexibility from pre-measurement to half-measurement, no further improvements were observed from half-measurement to post-measurement, indicating that creative performance did not improve further with longer duration. longer. from the training.

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