Students Creativity Through Digital Mind Map

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Abstract. This study aims to determine student creativity through digital mind maps. This type of research is quasi-experimental with a nonequivalent pretest posttest control group design involving 54 students of Universitas PGRI Sumatera Barat, Indonesia. The research instrument is a creativity assessment sheet equipped with an assessment rubric with indicators including keywords, material suitability, organization and layout, material completeness, creativity, image symbols and curved lines, and the use of color. The data collection technique was by giving a mind map test at the beginning of the meeting (pretest), and during the final test (posttest) which was collected via a predetermined email. Data analysis used Ancova, using prerequisite test consisting of normality test and homogeneity of variance test. The results of the analysis show that the average score of creativity through digital mind maps obtained by students (83.04) is higher than the average score of student creativity without using a digital mind map, namely (74.19). This finding shows that students' creativity increases through digital mind map. It was concluded that the digital mind can be used as an alternative in empowering student creativity.

Keywords: Creativity · students · digital mind map · learning

1 Introduction

Creativity is a higher order thinking skill that has evolved from other skills such as remembering, understanding, applying, analyzing and evaluating [1], as well as skills to find new things that have not existed before, such as being original, developing new solutions for each problem and involving the ability to solve problems to generate new ideas [2].

Creativity is needed in various areas of life to face life's challenges. Like intelligence and learning ability, creativity is not a characteristic that a person has or does not have, but can be taught so that students can learn to be more creative [1].

The fact shows that many research results in Indonesia report that student creativity is still low [3–5]. The low creativity of students is thought to be caused by the learning process that has not maximally accommodated the development of creativity [6].

Improving student creativity requires an innovation, so it is very important to make changes in the learning process, namely the active learning process. The active learning

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process can make students learn to build their own knowledge [7], which then applies actively in learning through a discussion process [8], so that collaboration in learning is established which indirectly builds creativity [9].

Building creativity through exploration of creative ideas in the learning process can improve students' thinking skills, especially in writing creative ideas. Then we need media or tools to develop these ideas. One of the tools or media or tools is a digital mind map (DMM).

Digital mind map (DMM) is a medium for conceptualizing knowledge, exchanging ideas, and exploring ideas, as well as providing a stimulus in the form of visual elements making mind maps that are made easy to analyze, understand and memorize to see the relationship between parts of information from problem solving linear text [10].

The role of DMM as a tool to stimulate creativity and collaboration, as well as increase their confidence in contributing ideas [11]. According Al-Jarf's that DMM can encourage creativity because it makes students more proficient in generating and forming increasingly complex ideas to write down [12], and DMM can be used to assess creativity [13]. Therefore, based on the description that has been presented, the purpose of this study is to determine student creativity through digital mind map.

2 Theoretical Review

2.1 Creativity

Creativity is a person's ability to produce new products and ideas as well as a problem solver [14], or an improvement on existing knowledge [15]. Creativity makes learning more meaningful [16], because creativity is related to students' knowledge and skills that can produce a useful product [17].

The development of creativity is one of the important goals of higher education activities [18], and is seen as an urgent need because creativity can encourage students to be more active in learning [19]. Creativity in the classroom forms a creative learning environment where students are more likely to express their ideas and think creatively [20].

DeHaan found that students need to be reminded repeatedly and demonstrate how to be creative by integrating material, questioning their own assumptions, and imagining other points of view and possibilities [21]. In addition, students' creativity can develop if students are taught to develop the dimensions of creativity products in an original, flexible, and fluent way [22].

2.2 Digital Mind Map

Digital mind map (DMM) is a single compressed file that can be used in software, besides that DMM is a diagram that has a single focal point which then produces several branches and sub-branches that represent their relationship to the center [23].

DMM applications can offer flexibility that a piece of paper cannot. DMM can organize, structure, and visualize thought processes. DMM is a tool to activate students, stimulate their creativity and collaboration, and increase their confidence in contributing ideas in the classroom [11].

The essence of DMM refers to the theory proposed by Buzan which consists of 5 components, namely the center of the mind map, branches, keywords, images and colors [24]. DMMs can be structured in a non-linear format with colors, numbers, fonts, images, or videos all available in an application [25]. Available applications are useful to assist in creating, managing and saving DMMs, such as Coggle, Freemind, Mindjet, MindNode, XMind, SpiderScribe.net, iMindMap, MindMiester, and Popplet [26]. In addition, DMM can organize, structure, and visualize thought processes.

DMM has a very important role in critical thinking skills, creativity, as reported by Clark, that the use of DMM improve students' motivation in class and higher order thinking skills [27]. Added by Hidayati, that the PBL and DMM models can be used as alternative approaches to empowering critical thinking and creativity of biology students [28], and supported by the opinion of Jbeili (2013) that the use of DMM for students can help improve learning achievement [29].

3 Method

3.1 Research Design

The type of research used is a quasi-experimental research design with a *pretest posttest nonequivalent control group design* as presented in Table 1.

Information

O_1 = Experimental class pretest score
O_2 = Experimental class posttest score
X_1 = Group learning
X_2 = Learning without groups
O_3 = Control class pretest score
O_4 = Control class posttest score

3.2 Population and Research Sample

The research population was all students of the Biology Education Study Program, Universitas PGRI Sumatera Barat, with a research sample of 54 students who had been enrolled in two classes of Higher Plant Taxonomy courses. Determination of the experimental class and control class through random techniques or randomly, where the experimental class numbered 28 people and the control class 26 people.

Table 1. Research design

Class	Pretest	Treatment	Posttest
Experimental	O_1	X1	O_2
Control	O_3	X2	O_3

3.3 Research Procedure

The treatment in the experimental and control classes was given a pretest in the form of a test in the form of making a digital mind map by students. The results of digital mind maps made by students are stored in pdf format which is sent to the specified email. Furthermore, different treatment was given to the learning process between the experimental and control classes. The final stage of the research was given a posttest in the form of a test in the form of making a digital mind map by students, then the results of the digital mind map made by students were saved in pdf format which was sent via email, then printed for assessment.

3.4 Research Instruments

The research instrument in the form of a creativity assessment sheet equipped with an assessment rubric refers to Monet & Connor [30], with indicators including keywords, material suitability, organization and layout, material completeness, creativity, image symbols and curved lines, use of color. The score range for measuring digital mind map creativity ranges from 0–4 for each indicator, where the reference is to check each item with criteria (4 being very good, 3 being good, 2 being fair, 1 being poor, and 0 being very poor).

3.5 Data Analysis

Data analysis used the normality test using the Kolmogorov-Sminov test, while the homogeneity test used the Levene test. After obtaining normal and homogeneous data, Anacova analysis was then carried out to see the effect of digital mind maps on creativity.

4 Results and Discussion

4.1 Normality and Homogeneity Test Results of Student Creativity

The results of the normality test and homogeneity test were obtained from the students' creativity pretest and posttest data which are presented in Table 2.

4.2 Hypothesis Test Results

The results of the research hypothesis testing using the Ananova technique are shown in the summary results of the hypothesis test results presented in Table 3.

Based on the results of Ancova, an analysis was carried out to determine the average correction in each class. The summary of the average corrected student creativity through digital mind maps based on different learning is presented in Table 4.

Table 4 shows the average corrected experimental class is 83.04, while in the control class it is 74.19. This explains the creativity of students through digital mind map better. The results of this study indicate that digital mind map can increase student creativity as presented in Fig. 1 and Fig. 2.

Table 2. Normality test results and student creativity homogeneity test

Creativity	Normality (Kolmogorov Test)		Homogeneity (Levene's Test)	
	N	Sig	N	Sig
Pretest	54	0.63	54	0.17
Final test	54	0.32	54	0.68

Table 3. Summary of Ancova Test Results on Student Creativity at Universitas PGRI Sumatera Barat

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1906.971 [a]	2	953.485	19.840	.000
Intercept	8434.785	1	8434.785	175.510	.000
Pre_Mastery_Concept	539.166	1	539.166	11.219	.002
Model	1018.302	1	1018.302	21.189	.000
Error	2450995	51	48.059		
Total	339505.417	54			
Corrected Total	4357.965	53			

Table 4. Summary of Student Creativity Average Results at Universitas PGRI Sumatera Barat

Class	Pre-test	Final test	Difference	Corrected mean
Experiment	55.28	83.63	28.35	83.04
Control	51,12	73.56	22.44	74.19

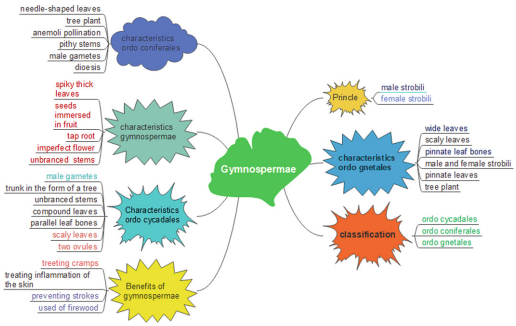

Fig. 1. Example of Student Creativity through a DMM Using the Mimind Application

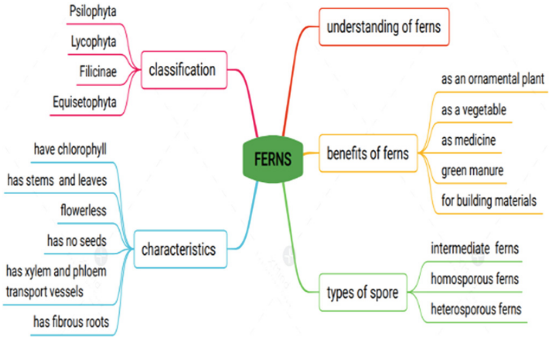

Fig. 2. Student Creativity through a DMM Using the Mindomo Application

The results of the DMM in Fig. 1 using the Mimind application show the branches of the knowledge ideas obtained, because knowledge can improve individual performance in creative tasks because there is a relationship between task structure and knowledge base [31]. Creativity is related to the ability to recognize ideas, find new solutions, and maximize efforts to produce something different [32].

Figure 2, a digital mind map made by students using the Mindomo application by making branches from the knowledge ideas obtained. Each of the digital mind maps guides and supports students to achieve learning goals [33], makes students better understand and memorize overall concepts and makes students enjoy learning [28], making students motivated to improve their knowledge concepts [30]. Because in making a mind map students need to compile, organize, and reconstruct relevant knowledge and understand the content of that knowledge independently [34].

Students' DMM creativity shows the development of ideas explained through its branches. For example, in the DMM, the angiosperm material in the main branch that describes the characteristics of monocot plants at the branch level is quite a lot, as well as the main branch regarding the classification of the branch level more than the other branches. Also, each one is given a different color of the ideas that appear to make it easier to remember and make the results look more interesting. Color makes digital mind maps more effective and provides tremendous benefits for storing and remembering them better [35].

5 Conclusion

Use of digital mind map in learning can increase student creativity, so digital mind map is recommended to be used in the learning process to empower creative thinking. This research was only conducted on biology education students, therefore, it is recommended that further research be carried out by exploring and applying appropriate DMM in a wider context, such as at different levels of education and in various scientific fields.

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References

1. Suprapto, Zubaidah. S, Corebima, A.D. Pengaruh Gender terhadap Keterampilan Berpikir Kreatif Siswa pada Pembelajaran Biologi. Jurnal Pendidikan, 2018, Vol. 3, No. 3, Hal 325—329
2. Leen, C.C., Hong, H., Kwan, F,N,H & Ying, T.W. Creative and Critical Thinking in Singapore Schools. NIE Working Paper Series No. 2, 2014
3. Zuhriyah, M., Agustina, R.K. & Fajarina, M. The Influence of Students' Creativity to Construct Sentences toward Their Speaking Skill. Register Journal, 2018, Vol. 11, No. 1, pp 1-18. DOI: https://doi.org/10.18326/rgt.v11i1.1-18
4. Dwikoranto, Munasir, Setiani, R., Suyitno, Surasmi, W.A., Tresnaningsih. & Pramonoadi. Effectiveness of Project Based Laboratory Learning to Increase Student's Science Process Skills and Creativity. IOP Conf. Series: Journal of Physics: Conf. Series 1491, 2019. Doi: https://doi.org/10.1088/1742-6596/1491/1/012006
5. Widiati, I., Turmudi. & Juandi. Pre-service Mathematics Teachers Creativity in De- signing Mathematics Assessment Based on Education For Sustainable Development. Inter- national Conference on Mathematics and Science Education 2019 (ICMScE 2019). Journal of Physics: Conference Series 1521, 2019. doi: https://doi.org/10.1088/1742-6596/1521/3/032061.
6. Birsa, E. Teaching Strategies and the Holistic Acquisition of Knowledge of the Vis- ual Arts. Center for Educational Policy Studies Journal, 2018, 8(3), 187–206. https://doi.org/10.26529/cepsj.39
7. Reigeluth, C.M. & Carr-Chellman, A.A. Understanding Instructional Theory. In. C.M. Reigeluth & .A. Carr-Chellman (Eds.), Instructional Design Theories and Models Volume III: Building a Common Knowledge Base, 2009, (P: 3–26). New York: Routledge. https://doi.org/10.4324/9780203872130
8. Singh, S. & Yaduvanshi, S. Constructivism in Science Classroom: Why and How. International Journal of Scientific and Research Publications, 2015, Vol 5, Issue 3.
9. Romero, M., Hyvönen, P. & Barberà, E. Creativity in Collaborative Learning across the Life Span. Creative Education, 2012, Vol.3, No.4, pp. 422–429. https://doi.org/10.4236/ce.2012.34066
10. Naghmeh-Abbaspour, B., Rastgoo, V., Fathi, N. & Yek, M.Z. The Use of Mindomo Software to Improve the Logical Development of EFL Learners' Writing. International Jour- nal of Innovation, Creativity and Change, 2019, Vol 8, no. 12. www.ijicc.net
11. Umami, R. The Effectiveness of Using Digital Mind Mapping toward the Students' Achievement in Writing Descriptive Text to be the First Grader at MAN 2 Tulungagung in Academic Year 2015/2016. Thesis. English Education Departement Faculty of Tarbiyah and Teacher Training. IAIN Tulungagung, 2016
12. Al-Jarf, R. Enhancing Freshman Students' Writing Skills with a Mind Mapping Soft- ware. Paper presented at the 5th International Scientific Conference, eLearning and Software for Education, Bucharest, 2009.
13. Rahayu, P. Susantini, E. & Oka, D.N. Development of Creative Mind Map Rubric to Assess Creative Thinking Skills in Biology for the Concept of Environmental Change. International Journal of Innovation and Research in Educational Sciences, 2018, Vol. 5, no. 2.

14. Glaveanu, P.V. Educating which creativity. *Thinking Skills and Creativity*, 2018, 27: 25- 32 https://doi.org/10.1016/j.tsc.2017.11.006
15. Dell, B., Garrick, R., Romanowski, C. & Slifka, M. *Using Mind Mapping to Influence Creativity and Innovation. Institute of Technology*. 2012, Retrieved from http://www.in- diana.
16. Thomsen, Bo. S. Assessing Creativity: A palette of possibilities. The LEGO Foun- dation. An Essay Collection, 2020.
17. Leggett, N. Early Childhood Creativity: Challenging Educators in Their Role to In- tentionally Develop Creative Thinking in Children. *Early Childhood Education Journal*, 2017, vol. 45, no. 6, pp. 845-853. https://doi.org/10.1007/s10643-016-0836-4
18. Długosz, M.W. Stimulating the Development of Creativity and Passion in Children and Teenagers in Family and School Environment - Inhibitors and Opportunities to Overcome them. *Procedia* - Social and Behavioral Sciences, 2015, 174 (2905 – 2911).
19. Yusnaeni, Corebima, A. D., Susilo, H., & Zubaidah, S. Creative Thinking of Low Academic Student Undergoing Search Solve Create and Share Learning Integrated with Metacognitive Strategy. *International Journal of Instruction*, 2017, 10(2), 245–262. https://doi.org/10.12973/iji.2017.10216a.
20. Al Hashimi, S., Al Muwali, A., Zaki, Y., & Mahdi, N The Effectiveness of Social Media and Multimedia-Based Pedagogy in Enhancing Creativity among Art, Design, and Digital Media Students. *iJET* – 2019, Vol. 14, No. 21. https://doi.org/10.3991/ijet.v14i21.10596
21. Dehaan. Teaching Creativity and Inventive Problem Solving in Science. CBE— Life Sciences Education, 2009, 8: 172–181.
22. Mukhopadhyay, R & Sen, M.K.. Scientific Creativity-A New Emerging Field of Research:Some Considerations. *International Journal of Educational and Psychological Research,* 2013, 2:1, 1-9
23. Krasnic, T. How to Study with Mind Maps; Concise Learning Method. Concise Books Publishing. 2012.
24. Buzan. The Mind Map Book. London. BBC. 2004.
25. Pati, P. Managing Creativity and Innovation. asci.org.in Daley, B. J., Morgan, S., & Beman, S. B. (2016). Concept Maps in Nursing Education: A Historical Literature Review and Research Directions. Journal of Nursing Education, 2003, vol. 55, no. 11, pp. 631–639. https://doi.org/10.3928/01484834-20161011-05.
26. Vittu, P & Gilles, R. Mind Mapping: Making Connections with Images and Color. Delta Journal of Education, 2016, Vol. 6, no. 2.
27. Tungrapa, T. Effect of Using the Electronic Mind Map in the Educational Research Methodology Course for Master-Degree Students in the Faculty of Education. International Journal of Information and Education Technology, 2015, Vol. 5, No. 11. https://doi.org/10.7763/ijiet.2015.v5.615
28. Hidayati, N., Zubaidah, S., Suarsini, E., Praherdhiono,. Examining the Relationship between Creativity and Critical Thinking through Integrated Problem-based Learning and Digital Mind Maps. *Universal Journal of Educational Research.* 2019, 7 (9A): 171-179
29. Jbeili, I.M.A., The Impact of Digital Mind Maps on Science Achievement among Sixth Grade Students in Saudi Arabia. 13th International Educational Technology Conference. *Procedia - Social and Behavioral Sciences* 103, 2013, 1078 – 1087
30. Monet, B & O'Connor, R. *The Use of Mind Mapping as an Assessment Tool, Dublin:* Institute of Technology Tallaght . 2011.
31. Ren, Y & Jiang, X. A Mind Map Teaching Mode for Sports Anatomy based on 3DBody. iJET – 2019, Vol. 14, No. 10. https://doi.org/10.3991/ijet.v14i10.10776
32. Adnan, A. H. M. & Zamari, Z. M. "I am a Techno-Rebel!" Malaysian Academics & their Personal Experiences of Progressing Into E-Learning. Procedia - Social and Behavioral Sciences, 2012, 67: 61-72 https://doi.org/10.1016/j.sbspro.2012.11.307

33. Batey, M.. The Measurement of Creativity: From Definitional Consensus to the In- troduction of a New Heuristic Framework. Creativity Research Journal, 2012, vol. 24, no. 1, pp. 55–65. https://doi.org/10.1080/10400419.2012.649181
34. Tan, L. S., Lee, S. S., Ponnusamy, L. D., Koh, E. R. & Tan, K. C. K. Fostering Creativity in the Classroom for High Ability Students: Context Does Matter. Education Sci- ences, 2016, vol. 6, no. 4, 36. https://doi.org/10.3390/educsci6040036
35. Lai, C.H. Jong, B.S. & Hsia, Y.T. Applying Concept Map to Game-Based Concept Assess- ment. iJIM – 2020, Vol. 14, No. 6. http://www.i-jim.org. https://doi.org/10.3991/ijim.v14i06.12057