JPPIPA 8(6) (2022)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Provision of Creative Teaching Materials in Improving Creative Disposition and Creative Thinking Skills of High School Students

AA Sukarso[1*], I Putu Artayasa[1], Syamsul Bahri[1], Afriana Azizah[1]

[1] Biology Education Study Program, University of Mataram, Indonesia

Received: October 28, 2022
Revised: December 17, 2022
Accepted: December 23, 2022
Published: December 31, 2022

Corresponding Author:
AA Sukarso
asukarso@unram.ac.id

DOI: 10.29303/jppipa.v8i6.2514

Abstract: This study examines the use of creative teaching materials in building students' creative thinking skills. The research sample was 53 students of class X one of the public high schools in Mataram. Instruments for learning activities in the form of creative teaching materials modified by the Writing to Teach approach, student books and data collection instruments. Creative dispositions were measured using closed questionnaires on inquisitive, persistent, imaginative, collaborative and disciplined aspects. Students' creative thinking skills were measured using a creative thinking skills test in the form of five essay questions on viruses. The results of the study show that the use of creative teaching materials triggers creative dispositions in the five aspects of inquisitive, persistent, imaginative, collaborative and disciplined aspects, also improves creative thinking skills where the average score of classes using creative teaching materials is higher than the average score in classes using books student package. Students' creative thinking skills improve in all aspects of creative thinking skills (flexibility, fluency, elaboration and originality). This shows that the use of creative teaching materials provides better conditions for the development of students' creative thinking skills.

Keywords: Creative Teaching Materials; Creative Disposition; Creative Thinking Skills.

Introduction

The generation of students living today grew up in a very different world from the lives of previous generations. Students live in an era of very rapid development of science and technology. The industrial revolution 4.0 as a phase of the technological revolution has changed the way human activities are carried out in scale, scope, complexity, and transformation from previous life experiences. Students will even live in global uncertainty. In the future, they will be faced with a period where life is competitive in almost all areas of life. In this context, students need to pay more attention to their abilities to predict and adapt to an uncertain and rapidly changing future. In particular, it is necessary to develop new competencies that enable students to offer solutions so they can be adaptive and ready to face life in the future.

Creativity is one of the important competencies that must be grown in every student. Creativity is the root of the ability to provide innovative solutions that are very important for the advancement of science, needed in the future work and economic development of students. Creativity is important in life and work environment because it describes a core aspect of human adaptability (Runco, 2017). Experts agree that creativity affects the performance of a society (Lamb et al., 2017; Rodríguez et al., 2019), therefore creativity needs to be developed.

Growing student creativity must be a priority in the current education system. The challenges of student life in the 21st century must be anticipated through learning that emphasizes critical thinking, creativity (creative thinking), collaboration skills and skills in communication. Creativity works in generating new ideas and giving birth to many innovations. Innovation as a result of divergent thinking will bring innovators to exist more in facing life. Innovation does not need to be extraordinary in nature but may be simple, different, unique and beneficial, and these skills can be taught. Making students as innovators because the development of their creativity is not a necessity.

How to Cite:
Sukarso, A., Artayasa, I.P., Bahri, S., & Azizah, A. (2022). Provision of Creative Teaching Materials in Improving Creative Disposition and Creative Thinking Skills of High School Students. *Jurnal Penelitian Pendidikan IPA*, *8*(6), 2728–2736. https://doi.org/10.29303/jppipa.v8i6.2514

Education plays a role in providing support to encourage creative potential to emerge and develop to achieve full creativity (Crismond, 2001). The potential for creative thinking that creates creativity is found in all human beings, and this potential can be increased through training. Many research results imply that teachers understand the concept and understand the importance of teaching creativity to students, but do not develop it (Runco, 2017). There are still many teachers who lack confidence in their competencies and teachers have a perception gap about creative potential with creative abilities. Teachers are concerned about not teaching creativity to students because it has the potential to reduce academic achievement targets, even though Cromie's (2003) research findings indicate that intelligent students are not always creative.

Which learning methods and approaches are used by the teacher greatly influence and determine student learning styles. Learning problems that are not real and do not touch students' daily lives, are often underestimated by students and in the end lead to boredom, their learning motivation decreases and even disappears, even though motivation is important to encourage creativity. The adoption of active learning strategies is more effective in promoting creativity than traditional learning strategies. Several studies have applied pedagogical approaches based on investigation, problem solving, and interdisciplinary learning, apart from being useful in building long-term knowledge retention, it can also promote student creativity (Sukarso, 2019).

Teaching materials are materials designed to enrich the learning process and contribute to better learning (Ankabi, 1989). Teaching materials used in the learning process must be in accordance with the needs of the curriculum and the development of students (Sinaga, 2015). Teaching materials contain explanations about theories, concepts or scientific phenomena. The explanations written in teaching materials must be well understood by the reader. Based on the behavioristic theory of stimulus and response, it is stated that the response of students in learning will depend on the stimulus given. Therefore, when a teacher wants a response from his students, the teacher must provide an appropriate stimulus for the response he expects. However, sometimes the available teaching materials are not in accordance with the needs of students, even though one of the considerations in the use or development of teaching materials is based on the needs of students (Brown, 1995).

The use of teaching materials (stimulus) in which there are misconceptions is one of the causes of misconceptions (responses) among students (Yunitasari et al., 2013). The analogy is the same as the use of teaching materials (stimulus) in which it does not or does not offer aspects of developing creativity, which is one of the reasons for the lack or lack of development of creativity (stimulus) in students. The study of student books, teacher books and other books as student learning references, it is still very rare to develop creative content. Writers generally focus more on presenting content-oriented material, even though the essence of mastering content is its application to the lives of students. The use of teaching materials that are not in accordance with these needs can result in the responses given by students not as expected. Therefore, the teacher should prepare his own teaching material so that it can be adapted to the conditions of students and obtain the response as expected.

One of the approaches used in writing to compose teaching materials is the Writing to Teach/WtT approach (Vazquez et al., 2012). The WtT approach has four stages: the planning stage, the writing stage, the peer review stage, and the revision stage. One of the teaching materials contains an explanation of concepts, while the explanation itself can be built using the structure of scientific arguments. Creative teaching materials can be prepared by modifying the WtT approach by adding creative examples, statements that challenge students' creative dispositions and explanations that open students' creative thinking insights and foster the desire to produce creative products based on the creative ideas they think about. We hypothesize that the use of creative teaching materials according to students' needs can build and develop students' scientific creativity.

Biology is one of the high school subject requirements with potential content to develop students' scientific creativity. Some high school biology content can be used as active and creative learning if packaged in creative teaching materials as well. The limitations of creative teaching materials to teach creative students in Biology are very important and urgent to do. The modifications made to the WtT approach are the originality of this research in providing creative teaching materials. In this study, the focus is how to make the description of teaching materials that are usually found in textbooks become creative teaching materials.

Method

This research was conducted on the student population of a public high school in Mataram class X in the 2022/2023 academic year, which consisted of six classes. Two classes of students, namely class X-2 and class X-3, were taken using a purposive sampling technique as research samples based on the similarity of the teachers who teach. The number of students in each class is the same as 34 students.

The research was conducted using a Quasi-Experimental Pre-test Post-test Design using an experimental class and a comparison class. The

experimental class conducted learning using WtT modified creative teaching materials and the comparison class used teaching materials sourced from student textbooks. The material developed for the topic of Viruses is given for odd semesters.

The learning activity instruments consisted of creative teaching materials using the modified Writing to Teach/WtT approach from Vazquez et al., (2012), student textbooks and data collection instruments. Creative teaching materials are teaching materials developed by researchers using a modified WtT approach by providing creative examples, challenging statements and illustrations that open students' creative thinking insights.

Creative disposition was measured using a questionnaire with closed answers using a Likert scale compiled by the researcher. The creative disposition questionnaire instrument was used to reveal creative habits triggered by the use of creative teaching materials. Creative dispositions are developed on inquisitive, persistent, imaginative, collaboration, and disciplined dimensions adopted from Lucas et al., (2013). The questionnaire was developed in 30 statements of students' creative habits of the closed answer type by expressing their agreement to the questionnaire statement by selecting the options Strongly agree, agree, sometimes, disagree and strongly disagree for positive statements and vice versa for negative statements.

Students' creative thinking skills were measured using a creative thinking skills test in the form of five essay questions developed by researchers on viruses. The questions that are made demand answers that cannot be found in books so that students are required to think and find creative answers. Assessment of students' creative thinking skills is based on four aspects of creative thinking skills as developed by Torrance (1979), which include fluency, flexibility, originality, and elaboration, using an assessment rubric developed by the researcher. All data collection instruments have previously been tested for their reliability and validity.

Analysis of research data was carried out using the t test to see differences in the results of the two classes. The test was assisted by the use of the SPSS version 26 program. The N-gain test was also carried out to determine the category of improvement that occurred both in terms of creative disposition or in improving students' creative thinking skills.

Result and Discussion

Use of Creative Teaching Materials Using a Modified WtT Approach in Growing Creative Dispositions

Creative dispositions are often interpreted as thinking habits, namely students' creative thinking tendencies when faced with questions or problems whose answers are not immediately known. In this study exploring creative thinking dispositions focused on creative behavior patterns of students in material about Viruses which were measured in five dimensions 1) Inquisitiveness; 2) Persistence or tenacity (persistent); 3) Power of imagination (imaginative); 4) Collaborative; and 5) Mastering the field of science (disciplined). Whether or not creative behaviors are shown by students in dealing with and solving problems is interpreted as the level of their creative disposition. The research results are summarized in Table 1.

Table 1. Recapitulation of Initial and Final Scores, N-Gain and Statistical Tests Creative dispositions of high school students

Component	Experiment Class		Comparison class	
	pretest	posttest	pretest	posttest
Number of Students	34	34	34	34
Average score	3.19	3.89	3.15	3.65
Standard Deviation	0.46	0.40	0.40	0.36
Minimum score	2.03	2.83	2.33	3.03
Maximum score	4.17	4.58	3.70	4.33
N-gain		0.38		0.24
Normality Test	0.940 (Normal)	0.254 (Normal)	0.381 (Normal)	0.694 (Normal)
Homogeneity Test	0.568 (Homogenous)	0.866 (Homogenous)	0.568 (Homogenous)	0.866 (Homogenous)
The average difference test (Independent Samples Test) initial score creative disposition experimental class and control class with a significance of 0.05				Sig. (2-tailed) = 0.935 $\alpha > 0.05$ H_0 accepted
The mean difference test (Independent Samples Test) the final creative disposition score of the experimental class and control class with a significance of 0.05				Sig. (2-tailed) = 0.002 $\alpha < 0.05$ H_0 rejected

The results of the analysis of the different test mean initial scores of students in the experimental class and the control class, in general, the two classes before the learning process were not significantly different. The results of the different test analysis of the mean final score showed that the creative disposition of students after learning in the two classes was significantly different. This means that the creative dispositions before learning between students in the experimental class and the control class were the same, but based on the results of the final test, they showed different creative dispositions. These results indicate that the use of creative teaching materials has a significant influence on students in increasing their creative dispositions.

Based on the increase in the mean creative disposition score obtained from each N-gain of the two classes, the experimental class experienced a greater increase than the comparison class. The average N-gain = 0.38, the experimental class is included in the medium category, while the control class N-gain = 0.24 is included in the low category. Based on the results of the research above, it can be inferred that the use of creative teaching materials triggers or awakens students' creative dispositions more than using regular teaching materials. Creative teaching materials can be seen as being able to enhance students' creative thoughts, as well as learning through investigative models (Haigh, 2007), project-based learning activities (Selçuk, 2010; Sukarso & Muslihatun, 2021). This finding will be very meaningful for biology science teachers. Research conducted by Hanke (2011) indicates the importance of creative dispositions for designing creative learning.

The increase in students' creative disposition scores is inseparable from the student learning process which is triggered by the provision of stimulus and examples of concept applications designed in creative teaching materials. Creative teaching materials open students' insights, opportunities, and authority to try to be active and involved in thinking beyond the main subject matter. Active learning includes every activity where every student has to think, create and solve problems (Graham et al., 2013). During learning, students are encouraged to be more active and take initiative in thinking and acting, while the teacher's role is to facilitate students in achieving their learning goals. Students are given great responsibility in thinking, thus triggering students to devote all their abilities to do their assignments. Ivcevic (2009) argues that the manifestation of a person's creative potential is influenced by the situation, social norms and cultural orientation. He further emphasized that situations that put pressure on psychological freedom can weaken an individual's creative potential. Social and cultural norms that emphasize the values of harmony and conformity can limit freedom of expression and consequently have an impact on the originality of the ideas produced. It is important to provide a social climate that provides open exploration opportunities so that students feel free and safe in exploring their creative potential which in turn will increase curiosity, insight, innovation, and motivate students' creative efforts.

Giving ill-defined problems in learning activities as a process of solving unusual problems can develop creative thinking and solve problems that are conditional on uncertainty (Ulger, 2018). Presentation of creative teaching materials accompanied by brainstorming and discussion activities triggers the emergence of new thoughts, ideas or ideas, seeks information, asks questions, explores ways or types of products related to problems, looks for possibilities that support solutions that will he made. The results of Sukarso et al. (2019) indicated that brainstorming mobilized students' creative thinking abilities to produce new, unique and useful ideas which were then developed into student project plans. The effectiveness of brainstorming activities in generating creative solutions, especially in generating new or unique ideas, has been previously proven by Boden's research (1998). Students' thinking activities that are carried out repeatedly tend to become habits, so that students will do the same thing when faced with similar problems.

Examples of challenging development materials trigger students to think imaginatively, ask many questions such as where to start, what are the main problems, what are the goals, what implementation must be done to eliminate problems and so on. According to Luckie et al. (2012) the time that students devote to compiling a design resulting from imagination is useful in increasing understanding and creative freedom. The preparation of plans for the manufacture of a product is positively correlated to the value of the new ideas generated (Kudrowitz & Wallace, 2013).

Provision of Creative Teaching Materials for the Development of a Modified WtT Approach in Developing Creative Thinking Skills

One indicator of the effectiveness of using creative teaching materials for the development of a modified WtT approach can be seen from the increase in creative thinking skills after learning compared to creative thinking skills before learning. The increase in creative thinking skills is shown by the initial and final results given through tests in the form of essays on Virus material in this study. Based on the results of the research, a summary of data on creative thinking skills of class X high school students was obtained as shown in Table 2.

Table 2. Recapitulation of initial and final scores of students' creative thinking skills

Component	Pretest		Posttest	
	Experiment Class	Comparison Class	Experiment Class	Comparison Class
Number of Students	34	34	34	34
Average score	21.40	19.13	61.49	38.84
Standard Deviation	660	5.48	11.43	9.67
Maximum score	43.50	33.5	82	61.81
Minimum score	9.50	12	38	24.83
Normality Test	0.768	0.216	0.099	0.861
	Normal	Normal	Normal	Normal
Homogeneity Test		0.349		0.110
		Homogenous		Homogenous
t-Test		Sig. (2-tailed) = 0.095		Sig. (2-tailed) = 0.000
		$\alpha > 0.05$		$\alpha < 0.05$
		H_0 acepted		H_0 rejected

Based on the statistical test with the t test, it was found that there was no significant difference in the initial scores of creative thinking skills between the experimental class and the comparison class, but there was a significant difference in the scores of creative thinking skills after the intervention. This shows that the creative thinking skills before learning between students in the experimental class and the comparison class are the same, but based on the results of the final test, they show different creative thinking skills. These results indicate that the use of creative teaching materials has a significant influence on students in improving their creative thinking skills. In other words, learning using creative teaching materials tends to be more able to encourage students to think creatively than learning activities using regular teaching materials.

The increase in the average score of creative thinking skills and N-gain in the experimental class and the comparison class, in Figure 1. Based on the diagram in Figure 1 (a) above, it can be seen that there was an increase in the creative thinking skills of the experimental class students which was higher than the comparison class before and after the learning activities. Experimental class students experienced an increase in the initial average value three times higher from 21.40 to 61.49. Meanwhile, the average value of creative thinking skills for the comparison class doubled from 19.13 to 38.84. This means that the experimental class students on average experienced a higher increase than the comparison class.

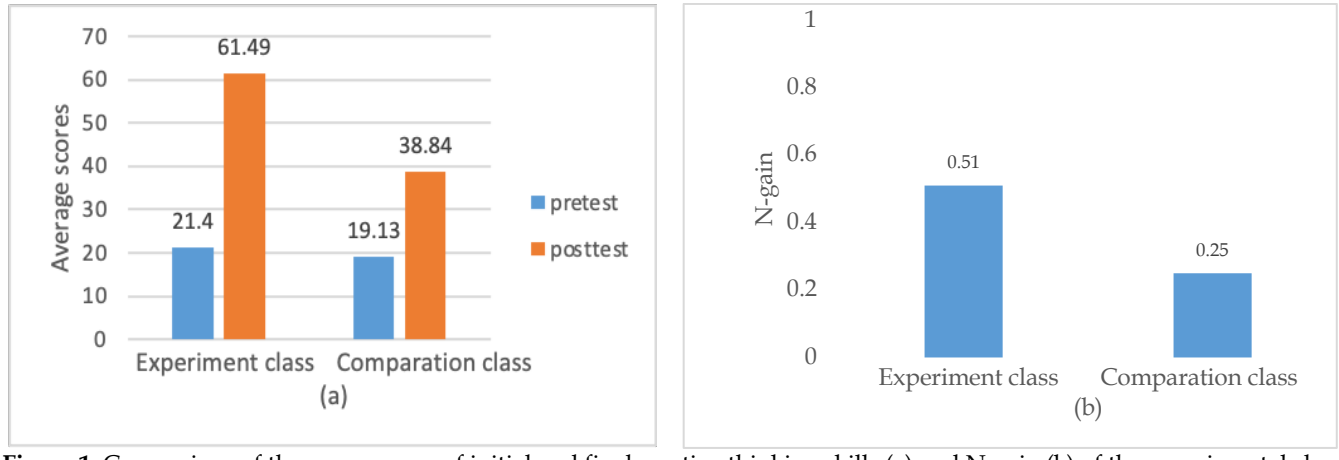

Figure 1. Comparison of the mean scores of initial and final creative thinking skills (a) and N-gain (b) of the experimental class and the comparison class.

Furthermore, based on the increase in the mean value of creative thinking skills obtained from each of the N-gain values of the two classes, the experimental class experienced a greater increase than the comparison class (Figure 1b). The increase in the value of creative thinking skills that occurred in the experimental class was N-gain = 0.51, two times higher than the comparison class with N-gain = 0.25. Based on the N-gain value obtained, the increase that occurred in the experimental class was included in the medium category and the comparison class was included in the low category. This means that the increase in students' creative thinking

skills in classes that use creative teaching materials is higher than classes that use regular teaching materials.

The results of this N-gain calculation are strengthened by data on students' N-gain scores for each category. Data on the percentage increase in students' creative thinking skills from each N-gain category are presented in Figure 2.

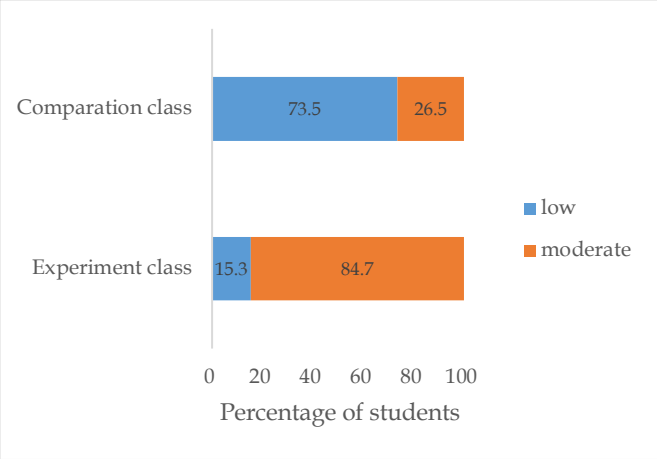

Figure 2. Percentage of the number of students according to the N-gain value criteria for their creative thinking skills in the experimental class and the comparison class/control class.

Based on the criteria for the N-gain value of their creative thinking skills, students are grouped into two criteria groups, namely medium and low (Figure 2). Nearly 85% of the experimental class students were in the medium category and 15.3% were in the low category. Meanwhile, the opposite happened to students in the comparison class, where only 26.5% of students were in the medium category and 73.5% were in the low category. Thus, it can be inferred that learning activities that use creative teaching materials have a positive role in improving students' creative thinking skills. Furthermore, the results of the N-gain mean different test of students' creative thinking skills in both classes are presented in Table 3.

Table 3. Mann Whitney U test results for N-gain students' creative thinking skills

Class	N	Average	Sig.
Eksperiment	34	0.509	0.000*
Comparation	34	0.247	

Sig. (2-tailed) 0.000 < 0.05

Based on Table 3 above, the results of the N-gain mean difference test for the experimental class and the comparison class obtained a sig value. 0.000 <0.05, which means that the results of the N-gain test mean different creative thinking skills for classes that use creative teaching materials are significantly different from classes that use student textbooks. Based on this, it can be interpreted that the increase in creative thinking skills of students who use creative teaching materials is better than students who use regular teaching materials.

The results of this test indicate that learning activities using creative teaching materials have a significant effect on improving students' creative thinking skills. Even so, the group of students who used regular teaching materials also experienced an increase in their creative thinking skills, although not as high as the class students who used creative teaching materials. It can be seen from the data that the group of students who used creative teaching materials experienced a higher increase in their creative thinking skills than the group of students who used regular teaching materials. Based on these findings, we can infer that the use of creative teaching materials tends to encourage learning activities that can develop students' creative thinking skills compared to the use of regular teaching materials. This is possible considering that creative teaching materials are designed to train students to develop broader insights by looking at examples from the outside world.

The test results as stated above, show that learning activities that use creative teaching materials in this study have a significant role in improving the creative thinking skills of class X high school students at one of the public high schools in Mataram, West Nusa Tenggara. The results of this study add to the body of knowledge and enrich the findings of previous studies. Research Yang et al. (2016) stated that investigative laboratory activities made significant progress in the performance of science investigations and students' scientific creative thinking, Chelang (2014) increased the scientific creativity of high school biology students. Some related research results also indicate that active student activity-based learning such as doing project activities, real practicum, creative research is effective for increasing achievement, logical and creative thinking skills, creativity, and the number of concepts produced (Ersoy and Başer, 2014; Yang et al., 2019; Ulger, 2018, and Sukarso, 2019) has a positive correlation with the effect size effect in increasing creative thinking and problem solving (De Haan, 2009).

The results of this study also show that the initial scores of students' creative thinking skills in both the experimental class and the comparison class tend to be low. Several results of previous research both in Indonesia and other countries indicate the same thing (Marwiyah, et al. 2015; Chelang, 2014; Tran et al. 2016; Daskolia et al. 2012; Moeed, 2013). This phenomenon of low creative thinking skills indicates that biology lessons are still lacking in developing students' creative thinking skills. According to Tin et al., (2010) the findings of low creative thinking skills from previous research indicate that teachers rarely carry out learning activities that they believe will increase creativity. Some of the reasons for

this include insufficient curricular time, lack of support from students, schools or parents, and low teacher self-confidence (McNally, 2006). Teachers find it difficult to formulate inquiry questions (Van Rens et al., 2010). Teachers also do not fully understand creative potential with students' creative abilities, most teachers agree that every student has creative potential but they do not believe students can think creatively (Ching Leen et al., 2014).

The low students' creative thinking skills in this study are related to the instructional model used by the teacher in teaching biology. The results of learning observations in biology classes indicate that teachers often use regular teaching materials and are not supported by the use of scientific examples or events or do not use approaches that can encourage children to develop their creative thinking skills. The use of such a learning approach seems to be justification for the teacher because it gets positive support from students. The results of the student questionnaire indicated that the method or strategy used by the teacher was more than 90% liked by students. If so, students tend to prefer teaching practices where the transfer of knowledge activity from teacher to student is still dominant. On the other hand such teaching methods can rob children of opportunities to think creatively.

Student learning activities both physical and non-physical during learning activities using creative teaching materials appear to be more developed. Presentation of examples of phenomena and explanations of challenging material tends to bring students to actively observe and explore other information in more creative ways such as using the internet to explore further the existing examples and explanations. Students discuss and collaborate with others to exchange information and try to think about other aspects. This high soft skill activity is thought to trigger the development of students' mind on potential such as students' creative thinking skills. The results of previous research by Oppezzo & Schwartz (2014) on the effect of high learning activity in the class showed that the score for divergent thinking was higher than the score for convergent thinking. In their discussion Oppezzo & Schwartz suspect that higher learning activities have a strong influence on the expression of associative memory. Chrysikou & Thompson-Schill (2011) explained that physical learning activities can release memory pressure, which will result in an increase in associative ideas. Memory pressure by (Lubow, 2010) called latent inhibition is the brain's ability to filter out ideas that may be irrelevant and adaptive ideas when stimulation occurs. This associative idea is explained by Nijstad et al. (2010) will awaken the flexibility of thinking without being limited by strong cognitive control that can interfere with the production of ideas.

Conclusion

Provision of creative teaching materials modified by the WtT approach can trigger the growth of creative dispositions and creative thinking skills in high school biology students. The results of the N-Gain analysis for both classes indicate that the provision of creative teaching materials has more potential to bring out students' creative dispositions in all dimensions of creative disposition (inquisitive, persistent, imaginative, collaborative and disciplined). These results indicate that the provision of creative teaching materials to bring out students' creative habits. The N-Gain of creative thinking skills (flexibility, fluency, elaboration and originality) for the class of students who were provided with creative teaching materials was also higher than the class of students who were provided with teaching materials based on student textbooks. The intervention of creative teaching materials modified by the WtT approach has more potential in improving students' creative thinking skills.

Acknowledgements

We thank the Rector of Unram and LPPM for facilitating this research budget.

References

Ankabi, M. (1989) Status of implementation of the national policy as it relates to intructional materials. *Negeria Education Research Association* (NERA). 253-261.

Boden, M. A. (1998). Creativity and artificial intelligence. *Artificial Intelligence*, 103(1–2), 347–356.

Brown, J.D. (1995). The Elements of Language Curriculum: A Systematic Approach to Program Development. Boston: Heinle & Heinle.

Chelang, C. (2014). Effects of practical investigation on scientific creativity amongst secondary schools biology students in Kericho district , Kenya . *Journal of Education and Practice*, *5*(8), 43–51.

Ching Leen, C., Hong, H., Ning Hoi Kwan, F., & Wan Ying, T. (2014). Teaching Creative and Critical Thinking in Singapore Schools. In *NIE Working Paper Series,* 2. Retrieved from http://hdl.handle.net/10497/17709

Chrysikou, E. G., & Thompson-Schill, S. L. (2011). Dissociable brain states linked to common and creative object use. *Human Brain Mapping*, *32*(4), 665–675. https://doi.org/10.1002/hbm.21056

Crismond, D. (2001). Learning and using science ideas when doing investigate-and-redesign tasks: A study of naive, novice, and expert designers doing constrained and scaffolded design work. *Journal of*

Research in Science Teaching, 38(7), 791–820. https://doi.org/10.1002/tea.1032

Cromie, W. J. (2003). *Creativity tied to mental illness: Irrelevance can make you mad*. Harvard Gazette. Retrieved from https://news.harvard.edu/gazette/story/2003/10/creativity-tied-to-mental-illness/10.21831/reid.v3i1.13294

De Haan, R. L. (2009). Teaching creativity and inventive problem solving in science. *CBE Life Sciences Education*, *8*(3), 172–181. https://doi.org/10.1187/cbe.08-12-0081

Ersoy, E., & Başer, N. (2014). The Effects of Problem-based Learning Method in Higher Education on Creative Thinking. *Procedia - Social and Behavioral Sciences*, *116*, 3494–3498. https://doi.org/10.1016/j.sbspro.2014.01.790

Graham, M. J., Frederick, J., Byars-Winston, A., Hunter, A. B., & Handelsman, J. (2013). Increasing persistence of college students in STEM. *Science*, *341*(6153), 1455–1456. https://doi.org/10.1126/science.1240487

Haigh, M. (2007). Can investigative practical work in high school biology foster creativity? *Research in Science Education*, *37*(2), 123–140.

Hanke, U. (2011). Effects of Creative Dispositions on the Design of Lessons. *The Open Education Journal*, 4(1), 113–119. https://doi.org/10.2174/1874920801104010113

Ivcevic, Z. (2009). Creativity Map: Toward the Next Generation of Theories of Creativity. *Psychology of Aesthetics, Creativity, and the Arts*, *3*(1), 17–21. https://doi.org/10.1037/a0014918

Kudrowitz, B. M., & Wallace, D. (2013). Assessing the quality of ideas from prolific, early-stage product ideation. *Journal of Engineering Design*, *24*(2), 120–139. https://doi.org/10.1080/09544828.2012.676633

Lamb, S., Doecke, E., & Maire, Q. (2017). Key Skills for the 21st Century: An evidence-based review. *New South Wales. Department of Education*. 1-70. Retrieved from https://inventorium.com.au/wp-content/uploads/2020/06/Key-Skills-for-the-21st-Century-Analytical-Report.pdf

Lubow, R. E. (2010). Latent inhibition. *Psychological Bulletin*, *79*(6), 398–407. https://doi.org/10.1017/CBO9780511730184.002

Lucas, B., Claxton, G., & Spencer, E. (2013). Progression in Student Creativity in School: First Steps Towards New Forms of Formative Assessments. *OECD Education Working Papers*, No. *86*. https://doi.org/10.1787/19939019

Luckie, D. B., Aubry, J. R., Marengo, B. J., Rivkin, A. M., Foos, L. A., & Maleszewski, J. J. (2012). Less teaching, more learning: 10-yr study supports increasing student learning through less coverage and more inquiry. *American Journal of Physiology - Advances in Physiology Education*, *36*(4), 325–335. https://doi.org/10.1152/advan.00017.2012

Marwiyah, S., Kamid, K., & Risnita, R. (2015). Pengembangan Instrumen Penilaian Keterampilan Berpikir Kreatif Pada Mata Pelajaran IPA Terpadu Materi Atom, Ion, dan Molekul SMP Islam Al Falah. *Jurnal Edu-Sains,* *4*(1), 26-31. https://doi.org/10.22437/jmpmipa.v4i1.2365

McNally, J. (2006). Confidence and loose opportunism in the science classroom: Towards a pedagogy of investigative science for beginning teachers. *International Journal of Science Education*, *28*(4), 423–438. https://doi.org/10.1080/09500690500404474

Moeed, A. (2013). Science investigation that best supports student learning: Teachers understanding of science investigation. *International Journal of Environmental and Science Education*, *8*(4), 537–559. https://doi.org/10.12973/ijese.2013.218a

Nijstad, B. A., De Dreu, C. K. W., Rietzschel, E. F., & Baas, M. (2010). The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology*, 21(1), 34–77. https://doi.org/10.1080/10463281003765323

Oppezzo, M., & Schwartz, D. L. (2014). Give your ideas some legs: The positive effect of walking on creative thinking. *Journal of Experimental Psychology: Learning Memory and Cognition*, *40*(4), 1142–1152.

Rodríguez, G., Pérez, N., Núñez, G., Baños, J. E., & Carrió, M. (2019). Developing creative and research skills through an open and interprofessional inquiry-based learning course. *BMC Medical Education*, 19(1), 1–13.

Runco, M. A. (2017). Comments on Where the Creativity Research Has Been and Where Is It Going. *Journal of Creative Behavior*, 51(4), 308–313. https://doi.org/10.1002/jocb.189

Sinaga, P. (2015). Factors influencing pre-service physics teacher' skill of writing teaching materials. *Proceeding of International Seminar on Mathematic Science and Computer Science Education* (MSCEIS. 2015). https://doi.org/10.1063/1.4941184

Sukarso, A. A., & Muslihatun, M. (2021). Mengembangkan Keterampilan Berpikir Kreatif, Sikap dan Kemampuan Bekerja Ilmiah Melalui Pembelajaran Praktikum Proyek Riset Otentik. *Jurnal Ilmiah Profesi Pendidikan*, *6*(3), 467-475. https://doi.org/10.29303/jipp.v6i3.268

Sukarso, A., Widodo, A., Rochintaniawati, D., & Purwianingsih, W. (2019). The potential of students' creative disposition as a perspective to develop creative teaching and learning for senior high school biological science. *Journal of Physics: Conference Series*, 1157(2019) 022092. 10.1088/1742-6596/1157/2/022092

Tin, T. B., Manara, C., & Tri, D. (2010). Views on creativity from an Indonesian perspective. *English Language Teaching* (ELT) *Journal*, 64(1), 75-84.

Torrance, E. P. (1979). An Instructional Model for Enhancing Incubation. *The Journal of Creative Behavior*, 13(1), 23–35.

Tran, L. T. B., Ho, N. T., & Hurle, R. J. (2016). Teaching for Creativity Development: Lessons Learned from a Preliminary Study of Vietnamese and International Upper (High) Secondary School Teachers' Perceptions and Lesson Plans. *Creative Education*, *7*(7), 1024–1043. http://dx.doi.org/10.4236/ce.2016.77107

Ulger, K. (2018). The effect of problem-based learning on the creative thinking and critical thinking disposition of students in visual arts education. *Interdisciplinary Journal of Problem-based Learning*, *12*(1), 3–6. https://doi.org/10.7771/1541-5015.1649

Van Rens, L., Pilot, A., & Van Der Schee, J. (2010). A framework for teaching scientific inquiry in upper secondary school chemistry. *Journal of Research in Science Teaching*, *47*(7), 788–806. https://doi.org/10.1002/tea.20357

Vazquez, A.V., McLoughlin, K., Sabbagh, M., Runkle, A.C., Simon, J., Coppala, B. P., and Pazicni, S. (2012). Eriting-to-teach: a new pedagogical approach to elicit explanative writing for undergraduate chemical students. *Journal of Chemical Education*, 89(8), 1025-1031. https://doi.org/10.1021/ed200410k