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GENDER RESPONSE ON LABORATORY ACTIVITY BASED ON CREATIVE RESEARCH PROJECT ON BIOLOGY CREATIVE THINKING SKILLS OF HIGH SCHOOL STUDENTS

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Abstract. The study of creative thinking skills has focused on creative research project-based laboratory activity for high school students' biology learning. This study aims to explore the differences in the creative thinking ability of male and female students. The participants of this study were students of X MIPA consisting of 22 males and 37 female students in a high school of Mataram, Lombok, NTB. Students completed a biological creative thinking skills test after completing a laboratory learning activity based on a creative research project required to be encouraged by actions and creative thinking. The results showed evidence of an improvement trend of creative thinking skills in all male and female students. However, statistical analysis using an independent sample t-test showed no significant difference to the mean scores obtained by male and female students. Based on the existing literature on developmental trends and gender differences in creative thinking, the study results are discussed.

Keywords: *creativity, creative thinking, research project laboratory work, gender*

INTRODUCTION

Enhancing students' creativity has been a focus and urgent need at this time. Students live at a time when a creative individual is highly valued and creativity becomes an ever-increasing to deal with a fast-changing world. Creativity is important for social and economic growth and thus can affect individual welfare [1]. Creativity is recognized as the root of providing innovative solutions providing for scientific progress and economic development. Therefore, creativity is students' future living pillar in the society of the 21st century.

Creativity becomes one of the core components of new abilities related to new ways of working. In other words, creativity is also an innovation. As something new, creativity can show quality and relevance to a particular work or context. Creativity is important both in life and the work environment because it describes a core aspect of human adaptability [2]. Experts agree that creativity affects society's performance. Therefore creativity needs to be developed [3,4].

If creativity is considered a necessity for a successful future life, then it is reasonable to expect creativity to become a priority in education. Education reforms such as the modification of the Curriculum of 2013 opens up the opportunity for students to learn and develop their creativity. Students' creativity can be developed without being limited by rules as long as the process and product of creativity can be accounted for academically. However, many societies consider that education places way too much emphasis on the domain of knowledge and lacks focus in an attempt to practice creativity to generate creative students. The learning process in school still involves a limited activity that requires creative thinking. Many schools suppress and even turn off creativity even though the school in the first place is responsible for building a system that supports the development of creativity rather than destroying the creativity itself [5], not to mention the curriculum, which often complicates the educational stakeholders to instill creativity into teaching activity [6].

That kind of learning system is responsible for students' low creativity in various places, including Indonesia. Based on the Global Creativity Index, Indonesian children were ranked 115 out of 139 countries involved in an International Survey in 2015 [7]. The result of the creative thinking skills study found that the ability is still at a low level [8-17].

Biological science must equip students to be creative. It provides a social climate that opens up opportunities for open exploration, enabling students to develop their creative potential. The material that suits this case is required to be close and related to real life. It allows students to explore the number of creations and innovations without losing the opportunity to understand the content in-depth. Biological science itself was born and shaped by creativity.

Project-based learning is a modern teaching method that connects students' experiences with school life. Experience is a crucial factor in acquiring knowledge. This study designed students to develop their creative thinking skills through several laboratory activities based on project research. The model of laboratory activity gives students a condition to plan and carry out the

research in the form of project activity. Students are given autonomy to work on the project, exploring various things through the research. Students' creativity is awakened through ideas generated from the process of creative thinking. Creativity and learning are considered as processes and products [18].

There is an impression that practical learning is exciting and thoughtfully implemented only by sure students. In order to help the school to stimulate students to be both active and creative in learning, a better understanding of the mechanism underlying creativity is needed [19]. Given that creativity is important for future life, individuals understanding differences that might be responsible for the creativity itself should focus on the study. The study aims to explore the individual creative thinking skill of male and female students after conducting biology laboratory activities based on a creative research project in high school students.

RESEARCH METHOD

The subject of this study was students in a class of X MIPA in one of the senior high schools in Mataram, Lombok, West Nusa Tenggara. The sample was 59 students consisting of 22 males and 37 females. Students are distributed in different classes, namely X MIPA 4 and X MIPA 6. The sample was determined by purposive sampling, namely the sample determination based on specific considerations or purpose in the study.

All participants in the group (Both X MIPA 4 and X MIPA 6 each consisted of four groups) were given treatment, namely laboratory activity based on creative research project-based. Each group consisted of 4-5 male and female students. Students in the group developed their research plan and implemented the plan to the laboratory activity like a project. The autonomy given to the student in the laboratory work is designed to trigger students to explore creative ideas by conducting brainstorming and in-depth discussion to develop their research plan. The activity is expected to allow students to develop their creative thinking skills. In order to make students' work be well organized, the activity was equipped with a Laboratory Activity Worksheet (LKP-1), which contains instructions to design a research plan and research report. Groups of students that conducted research on the topic of the Role of Bacteria in the Food Sector are divided into four sub-topics and problems to be investigated by students. The four sub-topics namely: LKP-2a; LKP-2b; LKP-2c; and LKP-2d. Each group only worked on one out of four topics of LKP-2, determined by voting through lottery. The model of LKP is not included in this paper.

Instrument test of creative thinking skills is adapted from Torrance Tes Creative Thinking (TTCT) which is used to measure creative thinking skills in this study. The test is in the form of 6 questions for an essay in the Mushroom Topic, which requires a student to provide creative ideas that are not in the textbook. Thus students must be creative in developing them according to their own thoughts. The assessment of students' creative thinking skills based on the four aspects of creative thinking skill which include fluency, flexibility, originality, and elaboration [20]. The test questions have been tested and have a test reliability coefficient (Cronbach's alpha) of 0,71 in the category of high alpha coefficient and a consistent index of the items classified as consistent. The students' answer score was carried out using an assessment rubric developed by the researcher.

The research data in the form of creative thinking skill score was analyzed using a statistical test using a two-mean difference test (t-test) using the SPSS version of 20 applications. Increasing creative thinking skills were analyzed using the normalized gain score equation [21] and interpreted according to Meltzer's criteria.

RESULTS AND DISCUSSION

The results of a statistic test found that the posttest score for male students was 61.3 while female students were 57.4. Both experienced a significant increase from the pretest score. However, there was no significant difference in the increasing score between male and female students (Table 1). It can be concluded that the laboratory work based on the creative research project can encourage students to think creatively even though the increased score of both students was not significantly different. This is probably because the activity gives equal opportunity to formulate various possibilities, think differently, and find solutions to the problems they seek during the laboratory activity. This finding is in line with the results of Haigh's study [23] that investigative laboratory activity can improve students' creative scientific thinking.

Other findings found that the pretest score of creative thinking skills between male and female students is deficient. This indicated that the learning process in school doesn't encourage students to develop their ability in creative thinking skills. Laboratory activity based on the creative research project can facilitate students to develop their creative thinking skills.

Laboratory activity based on the creative research project can encourage students to think differently and not fixate on the references in providing solutions to the problems. This also causes the improvement of the score of students' creative thinking skills.

Tabel 1. Recapitulation of pretest, posttest, and t-test scores of creative thinking skills for different gender

Component	Pretest		Posttest	
	Male	Female	Male	Female
Number of students (n)	22	37	22	37
Average score	21.95	23.97	61.27	57.43
Standard deviation	9.77	7.69	11.97	14.41
Maximum score	44	42	82	79
Minimum score	8	10	38	25
Normality score	0.200 (normal)	0.200 (normal)	0.29 (normal)	0.071 (normal)
Homogeneity score	0.279(homogen)		0.408(homogen)	
Hypotesis testing (Independent sample t test pretest score significance of 0.05			Sig. (2-tailed) = 0.382 $\alpha > 0.05$ H_0 accepted	
Hypothesis testing (Independent sample t test posttest score significance of 0.05			Sig. (2-tailed) = 0,297 $\alpha > 0,05$ H_0 accepted	

Based on the improvement of the creative thinking skill average score obtained from each male student, the N-gain score was 0.50, and the female students were 0.45, both in the medium category (Figure 1).

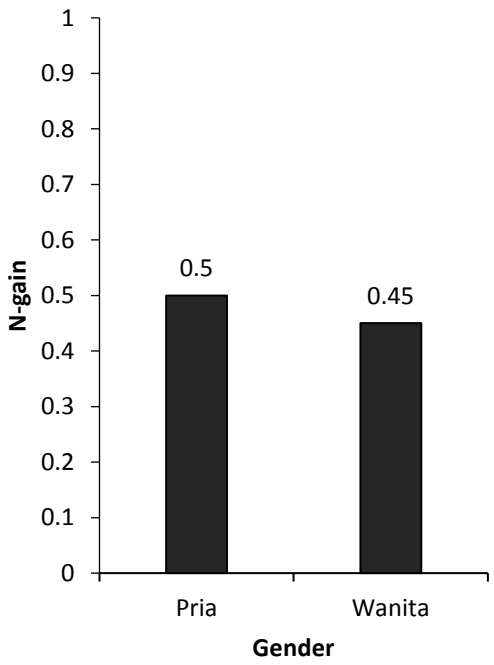

Figure 1. N-gain improvement of creative thinking skills in different genders.

Based on the picture above, it can be concluded that the laboratory activity learning based on a creative research project is designed to provide equal opportunity to all students regardless of their gender. Female students can emulate the creative performance of the male students. The study might unravel the mystery of gender differences in creative performance. Several studies found that females and males tend to differ in creative thinking. Compared to women, men are freer to express their thoughts and creative activities [25]. Women are more likely to focus on the needs of others, and they spontaneously become empathetic [26]. This has led to women becoming more oriented to other people's creativity and less oriented to their own needs, which differs from men's [27].

Personal needs are a motivating factor to improve creativity [28], but the interest in caring for others can increase the demand to act creatively [29]. Great motivation and goal that is people-oriented substantially improve fluent and original thinking. The study by Kemmelmeier and Walton [29] proved that when students are told that their creativity can benefit other people, female students become highly motivated to take part in creativity when others benefit. On the other hand, male students became highly motivated when they themselves benefited.

There are various explanations about gender differences in the creativity test score. According to Russ [24], emotional involvement affects the associated with society in the process of seeking creative tasks. Compared to female students, male students are freer to express their thoughts and creative activities. Reis [31] observed that many cultural demands interfered with creativity in women. When women grow up brainwashed by cultural values such as modesty and restraint, they tend to be hampered generating new ideas.

Gender differences in creativity have been subjects of extensive study [19]. However, literature doesn't allow any firm conclusion to be drawn. According to a comprehensive review by Baer and Kaufman [32], there is no consistent pattern of gender differences in creativity test scores. Sometimes the evidence supports that male students tend to think creatively[33], but other

findings found female students are more creative [34] and studies often report no gender difference [19]. At least, the study we conducted provides evidence that if given equal opportunity, male and female students have the same creative thinking potential.

Laboratory activity based on the creative research project can improve students' creative thinking skills in all aspects of creative thinking skills (Table 2). However, the increase of creative thinking skills scores is still not uniform for all aspects. The average improvement score was relatively high for fluency and flexibility aspects and was lower for elaboration and original aspects.

Fluency is a measure of the number or number of generated ideas [35]. Students who show fluency mean that they propose many ideas that might be the answer to a problem. The aspect of fluent thinking is seen as a sufficient condition for the manifestation of creativity [36]. Laboratory activity based on research creative project conditions a learning environment that encourages students' independence, risk taking, and intrinsic motivation. In a conducive environment, students are encouraged to learn to tolerate differences of opinion and encourage students to be confident in differences, convinced that everyone is capable of being creative [37]. This creativity can be stimulated through brainstorming and modeling [38]. This fluency thinking skill is still not optimal, proposed by Scheffer et al. [39] in fact, should not be considered a limiting factor in creativity.

Tabel 2. Average, standard deviation, N-gain, t-score for each skill dimension of high school male and female students creative thinking

Creative thinking dimension skills	Male (N = 22)			Female (N = 37)			t-score
	Average score	Std. Dev.	N-gain	Average score	Std. Dev.	N-gain	
Fluency	72,41	14,67	0,60	66,08	17,40	0,49	$0,280^{ns}$
Flexibility	69,68	14,60	0,57	65,16	16,82	0,51	$0,318^{ns}$
Elaboration	55,59	12,95	0,41	56,96	2,01	0,43	$0,621^{ns}$
Originality	46,68	14,95	0,41	41,76	2,80	0,36	$0,589^{ns}$

Description : $\alpha = 0,05$; ns = not significantly different

Flexibility thinking produces different perspectives or dimensions about a problem [16]. Creative thinking flexibility or the ability to change focus may be associated with fluent thinking that generates many responses [40]. According to Hu & Adey [41] creative people can develop many ideas to solve a problem. The more ideas generated to tackle the problem from a different perspective, the more flexible. Creative people offer solutions to problems from a different perspective.

On the other hand, people with a low level of flexibility show a rigid pattern of thinking. According to Akkaş [42], a student's flexibility can move from one approach to another due to the conditions and the use of different intellectual strategies. People who have more flexibility can easily switch from one approach to another.

Elaboration is related to students' thinking processes in which concepts, principles, procedures, and details are added to connect old information to new information that students are learning [43]. Elaboration thinking refers to the ability to clarify and add detail to an idea [44]. The average score of male and female students on the elaboration thinking aspect in this study is still low. Several other studies also show the same finding that elaboration thinking is a barrier to low divergent thinking compared to fluent thinking and flexible thinking [45, 46, 40]. It is suspected that students are still not used to using their creative thinking skills to elaborate on solutions or ill-structured problems. There must be an exciting interaction between critical and creative thinking [47].

Original thinking refers to the production of new ideas without any specific stipulation of whether these ideas will be helpful or not since the usefulness of ideas is not always immediately apparent. However, the originality of creative thinking of male and female students in this study was low. The achieved original thinking skills describe the level of students' ability to produce thoughts or actions that are considered unique, namely thoughts or actions that only a few people think about. According to Hu & Adey [41], the fewer students who think about the ideas they generate, the more original the ideas will be. Previous research by Alghafri & Ismail [48] also indicated that applying thinking skill strategy in science learning resulted in lower originality. One possible interpretation of this result is that students still lack the experience to think about unique, different, and come out as students' new thoughts. Students express creative thinking based solely on their current experiences. According to Runco et al.[49] students have not been able to think following the associative path and only imagine their ideas from their long-term memory. Students do not use their imaginative thinking but rely more on rote ideas and shallow experiences, reducing original ideas.

It is suspected that learning and giving tasks carried out in the class are more focused on the demand of learning realistically. Real problems or tasks may naturally lead to realistic ideas such as answers to tasks that are considered correct, feasible, and widely accepted. If so, then it will be far from directing the association of imaginative solutions and ideas. Such constraints can easily hinder divergent thinking that contributes to original thinking [46].

CONCLUSION

Based on the findings and discussions, it can be concluded that practical learning based on creative research projects does not cause differences in the creative thinking skills of male and female students. Male and female students showed equal creative thinking skills. Equal opportunity to behave when conducting project research minimizes the phenomenon of greater male or female variability.

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