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The Analysis of Creativity and Misconceptions of Elementary School Student Teachers in Science Learning through the Mind map in Virtual Classrooms

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Abstract

This research aimed at assessing the student teachers' creativity and detecting their misconceptions about the material of Organism Reproduction. This descriptive research involved a total of 28 students of elementary school student teachers. The Mind map was used as a tool to assess the students' creativity and misconceptions. The data were then analyzed descriptively with scoring techniques based on the Creative Mind map Rubric. The creativity assessment was categorized into four aspects including fluency, flexibility, originality, and elaboration. Of these four aspects, the highest level of achievement was on the fluency aspect (60.72%). Meanwhile, the lowest level of achievement was on the originality aspect (3.57%). The category of students' creativity was "Almost Not Creative" with the percentage of 39.29%. It means that on average each student only acquired one to two aspects of creativity. The students' misconceptions were detected almost in each sub material of Organism Reproduction. However the highest number of misconceptions was found in the material of Animal Reproduction, 21 times on the generative reproduction of vertebrates and invertebraes animals. This study provided an evaluation of alternative instruments to measure the students' creativity and misconceptions in science learning.

Keywords: *mind map, creativity, misconception, virtual classrooms.*

Abstrak

Penelitian ini bertujuan untuk menilai kreativitas mahasiswa calon guru dan mendeteksi miskonsepsi mereka pada materi Perkembangbiakan Makhluk Hidup. Penelitian deskriptif ini melibatkan 28 orang mahasiswa calon guru MI/SD. *Mind map* digunakan sebagai alat untuk menilai kreativitas dan miskonsepsi mahasiswa. Data kemudian dianalisis secara deskriptif dengan teknik penskoran berdasarkan *creative mind map rubric*. Penilaian kreativitas dibagi menjadi empat aspek, yaitu *fluency, flexibility, originality dan elaboration*. Dari keempat aspek tersebut *fluency* memiliki tingkat ketercapaian yang paling tinggi (60,72%). Sementara itu, aspek terendah adalah *originality* (3,57%). Tingkat kreativitas mahasiswa berada pada kategori *"almost not creative"* dengan persentase 39,29%. Ini berarti bahwa rata-rata setiap mahasiswa hanya menguasai satu hingga dua aspek kreativitas.

Miskonsepsi mahasiswa terdeteksi hampir di setiap sub materi Perkembangbiakan Makhluk Hidup. Namun demikian, jumlah miskonsepsi tertinggi ditemukan pada sub materi Perkembangbiakan Hewan, yaitu sebanyak 21 kali pada konsep perkembangbiakan generatif mengenai hewan vertebrata dan invertebrata. Penelitian ini memberikan alternatif instrumen evaluasi yang mampu mengukur kreativitas serta miskonspsi mahasiswa pada pembelajaran IPA.

Kata kunci: *mind map, kreativitas, miskonsepsi, kelas virtual*.

INTRODUCTION

Virtual learning is a current learning method widely used along with technological developments as a result of post-pandemic adaptation. According to Jr et al. (2021), digitalization has become an important factor in the process of delivering learning materials. Virtual learning has numerous benefits as it can combine different learning styles and reduce learning barriers. Chick et al. (2020) recommend the use of technology as an innovative solution in carrying out the education process. The OECD (Organization for Economic Co-operation and Development) suggests a number of learning options that can be used such as online website, educational television, existing online distance learning platform/resources, new online platforms (virtual classrooms) (Reimers & Schleicher, 2020). Mena & Isaias (2019) mention several applications that can be used as learning technology. These technologies are in the form of social network platforms, learning management systems, video conferencing, active learning tools, and collaboration tools. Examples of this kind of technology are Zoom, Google Hangouts, Kahoot!, Google Classroom, Skype, WebEx, and so on.

A preliminary study has been conducted through an online interview in one class in the Madrasah Ibtidaiyah Teacher Education (PGMI) Study Program regarding applications that can be used during the online lecture process. From the interview, it was found that most students chose Google Classroom (GC). The reason was because they were familiar with the application and had an experience of using it. In addition, GC could solve problems dealing with the limitations of internet connection and the high costs if video conferencing was required.

GC is a type of Learning Management System (LMS). Besides, according to the 12th Annual Digital Learning Tools Survey from the Center for Learning & Performance Technologies, Moodle and Edmodo are quite popular compared to other learning technologies as it is an appropriate choice of learning technology for students (Bothma & Cant, 2011; M. C. Cant & Bothma, 2010; Mena & Isaias, 2019). It is because the use of e-learning at the higher education level is starting to completely replace traditional teaching processes,

although some universities still use it as a complement to classical learning (Umek, Keržič, Aristovnik, & Tomaževič, 2015).

As part of the Learning Management System used in online lectures (virtual classes), GC plays a role in increasing the students' motivation and writing skills because of its easy use and practicality and it can be accessed from anywhere (Fonseca & Peralta, 2019). GC can facilitate task management, provide feedback, effective interaction between teachers and students, and improve problem solving skills; it can be combined with conventional learning (often referred to as blended learning) (Fauziah et al., 2019; Gunawan & Sunarman, 2018; Sabran & Sabara, 2019; Wicaksono & Rachmadyanti, 2017).

GC is an alternative option for conducting virtual classroom learning. Virtual class is a class run on a web basis where there is an interaction between educators and students without any time or space restrictions (Gunawan & Sunarman, 2018). This class is also commonly equated with e-learning. The use of e-learning will be better when combined with learning assessment instruments. Thus, educators can assess whether the learning they apply has a positive impact on the development of student knowledge (Al-Shagran & Sahraoui, 2017). However, assessment in electronic learning in reality has become a problem that has received less attention (Karran, 2004).

One method appropriate to be implemented with GC is the Mind map. Michalko (2001) explains that the Mind map is "an alternative to whole brain thinking to linear thinking where the mind map reaches out in all directions and captures various thoughts from all angles". This Mind map can integrate information and thoughts as well as a visual conceptual strategy. Mind mapping is a presentation form of radiant thinking, utilizing lines, colours, characters, numbers, symbols, image, pictures or keywords, etc. to associate, integrate and visualize the learned concept and evoke brain potential (Wang, Lee, & Chu, 2010). The purpose of making mind mapping is to provide a broad view of the subject matter, allow alternative routes or options, accommodate large data capacities, encourage creative problem-solving alternatives, in addition to its interesting nature to learn (Buzan, 2008).

Several previous studies related to mind mapping have been carried out. Choudhari & Desai (2017) and Liu et al. (2014) explained that the Mind map has various benefits, both for the learning and teaching process. In the learning process, the Mind map can help students to learn, communicate ideas, and organize the information obtained quickly. In the teaching process, teachers can use the Mind map to efficiently monitor and assess the students' understanding. This is supported by Alomari's (2019) statement that using Mind maps in learning the process of reading comprehensions is a unique method that captures the mental

constructions used by the learner and their understanding. This method also makes it easier for students to grasp the core of the learning curriculum and improve their knowledge structure (Stokhof et al., 2020).

The Mind map can also function efficiently as a student assessment tool by using a rubric in line with the desired learning outcomes (Choudhari & Desai, 2017). The Mind map is very well established to be used in complex learning themes. It can help students remember details that would be difficult if using the plain text (O'Connor, 2011). The Mind map can be used as an assessment in problem-based learning. This Map is also closely related to the reading comprehension indicator where it can clearly visualize the knowledge of students. This certainly helps lecturers find the basis for the development of learning needed by students.

Different from the previous studies, in this study, the Mind map is used as an evaluation instrument to measure the students' creativity and misconceptions. The ability to think creatively is one aspect that must be possessed by the 21st century generation. Therefore, the ability to think creatively needs to be instilled in students (Sartono et al., 2021). The use of the Mind map as an assessment instrument is still rare (Rahayu, Susantini, & Oka, 2018) even though it can overcome weaknesses in a number of assessment tools, especially in online learning, for instance in terms of objectivity and the possibility of cheating by students. In several studies, the use of a Concept Map than a Mind map was found to be more familiar. Previous research has successfully applied the Concept Map as a tool for evaluating the students' understanding in both conventional learning and in e-learning (Croasdell, Freeman, & Urbaczewski, 2003; La Vecchia & Pedroni, 2007). Angelo & Cross (1993) states in their book that to assess creative thinking skills, educators can use a Concept Map. Although they sound similar, the Concept Map and the Mind map have significant similarities and differences.

Science materials are complex so that the use of the Mind map is suitable. Several studies have shown that this method is effective for teaching science materials because it can improve the students' learning outcomes, interests, activities, and analytical thinking skills (Darsono, 2016; Intany, 2016; Purwanti, Prihanta, Muizzudin, & Permana, 2018; K. Putra & Nurdiniah, 2015; Safitri, 2016; Warjuni, 2013). Reproduction is one of the science concepts that student teachers in elementary schools/MI must master. According to Regulation of the Minister of Education and Culture No. 37 of 2018, this material is included in the standard content of the 2013 curriculum. Given the density of material that must be mastered by

MI/elementary school student teachers, there are many concepts they do not understand, which further lead to misconceptions (Desstya, Prasetyo, Suyanta, Susila, & Irwanto, 2019).

The definition of misconceptions according to Galvin and Simmie (2015) is the difference in understanding the concept of a person with scientific consensus that has been generally accepted. A number of studies have revealed that misconceptions can also occur among science teachers. This is very common and does not depend on a person's education level (Rai & Kumar, 2019). In a number of studies, Natural Science Material in general and the reproduction of living things in particular have the potential to cause misconceptions for students (Fardiansyah, 2015; Samiha et al., 2017; Uriyaha & Nuriman, 2018). Such misconceptions also occur in many elementary school student teachers (Laksana, 2016; Wijayanti, Fajriyah, & Suyitno, 2017). The existence of misconceptions in this material is the basis for selecting variables and samples in this study.

Apart from misconceptions, the Mind map also assesses the students' creativity. In Indonesia, creative thinking skills are one of the learning outcomes included in the 2013 curriculum (Rahayu et al., 2018). In the learning process in the classroom, the development of the creativity aspect is often neglected compared to the knowledge aspect (Vijayakumari & Kavithamole, 2014). Torrance in Vijayakumari & Kavithamole (2014) stated that there are four components of creativity including: fluency-the continuity of ideas, flow of associations and use of basic and universal knowledge; flexibility-changing ideas, approaching a problem in various ways and producing a variety of solutions; novelty-a unique way of thinking and unique products of mental or artistic activity; and elaboration –the ability to describe, illuminate and generalize ideas.

The Mind map is closely related to creativity. In some educational practices, this map is often used as a learning method to increase the creativity of students (Kulsum, 2018; Miranti & Wilujeng, 2017; Wang et al., 2010). Not only creativity, the Mind map also has a positive influence on innovation, learning, and understanding (Garrick, Romanowski, & Slifka, 2012). After analyzing the results of his research, Wette (2017) even found that the Mind map can provide very useful information to teachers about what students understand or do not understand, as well as identify problematic components of student knowledge.

The application of mind mapping can affect the success of a teacher in learning science (Hermansyah & Witarsa, 2017). The Mind map can be used as an evaluation tool for several variables at once, analyzing misconceptions (Nurlaila, 2016), and knowing the mastery of students' creative thinking abilities (Putri, 2016). Thus, a clear picture can be obtained. The Mind map can be used as an assessment tool for students in science learning. The use of the

Mind map in online learning during the pandemic through Google Classroom will make it easier for lecturers to assess students objectively. The Mind map can also be used to design active and adaptive e-learning or virtual learning . The Mind map method has been shown to define the characteristics of e-learning that has been adapted where the two can be combined effectively (Kedaj, Pavlíček, & Hanzlík, 2014; Stoyanov & Kirchner, 2004). The purpose of this study is to assess the students' creativity and detect misconceptions in the subject of Natural Sciences (IPA) and the reproduction of living things. The assessment instrument used is the Mind map, while the type of application used in virtual classes is Google Classroom.

METHODS

This research was a descriptive quantitative research. The research subjects consisted of 28 students. Learning was carried out in the MI/Elementary School Science Study and learning course attended by Madrasah Ibtidaiyah student teachers who were programming the course. This research began with the learning process in a virtual classroom through the Google Classroom application. Students were given a number of materials "Reproduction of Living Things" and a brief explanation of the procedure for making a Mind map. Learning was carried out through discussion and question and answer methods in virtual classrooms, followed by the task of making a Mind map.

Lecture materials on "The Reproduction of Living Things" consist of several indicators, namely: 1) Understanding how the reproduction in living things; 2) Distinguishing reproductive systems in animals, plants, and humans; 3) Describing the application of technology to animals, plants, and human reproduction. The Mind map making aimed to make a tool that could evaluate the students' creativity and detect misconceptions in understanding the learning material provided.

The data from the assignment in the form of a Mind map, also an assessment instrument in this study, were collected and analyzed descriptively. The first research variable measured was the misconceptions of student teachers, while the second variable measured was creativity that included 4 aspects, namely originality, fluency, flexibility in thinking ability, and elaboration ability (Putri, 2016; Vijayakumari & Kavithamole, 2014). The creativity assessment rubric was based on the Creative Mind map Rubric developed by Rahayu et al. (2018) as shown in table 1 below:

Table 1. Creativity Assessment Rubric (*Source: Rahayu et al., 2018*)

No.	Aspect	Indicator
1.	*Fluency*	Central Idea Keywords Color Usage Branching
2.	*Flexibility*	Basic Ordering Idea (BoI) Total Branch Total Sub Branch
3.	*Originality*	Word Usage Illustration/Picture Highlight
4.	*Elaboration*	Hierarchy Crosslink Relationship

Table 1 shows the indicators used in each aspect of the creativity variable measurement.

Table 2. Final Assessment Methods for Creative Thinking Level (CTL)
for Elementary School Student Teachers

CTL (Point)	Aspect				CTL	Interpretation
	Fluency	***Flexibility***	***Originality***	***Elaboration***		
CTL 0	-	-	-	-	CTL 0	*Not Creative*
CTL 1	🕑				CTL 1	*Almost Not Creative*
CTL 2		🕑				
CTL 3	🕑	🕑	🕑			
CTL 4	🕑		🕑	🕑		
CTL 5	🕑	🕑	🕑	🕑		
CTL 6	🕑	🕑	🕑	🕑	CTL 2	*Creative*
CTL 7	🕑	🕑	🕑	🕑		
CTL 8	🕑		🕑	🕑		
CTL 9		🕑	🕑	🕑		
CTL 10	🕑	🕑	🕑	🕑	CTL 3	*Very Creative*

Table 2 shows how the Creative Thinking Level is determined for each aspect of the creativity variable.

RESULTS AND DISCUSSION

The Creativity of Elementary School Student Teachers

The creativity of elementary school student teachers in science learning can be seen in Figure 1 below:

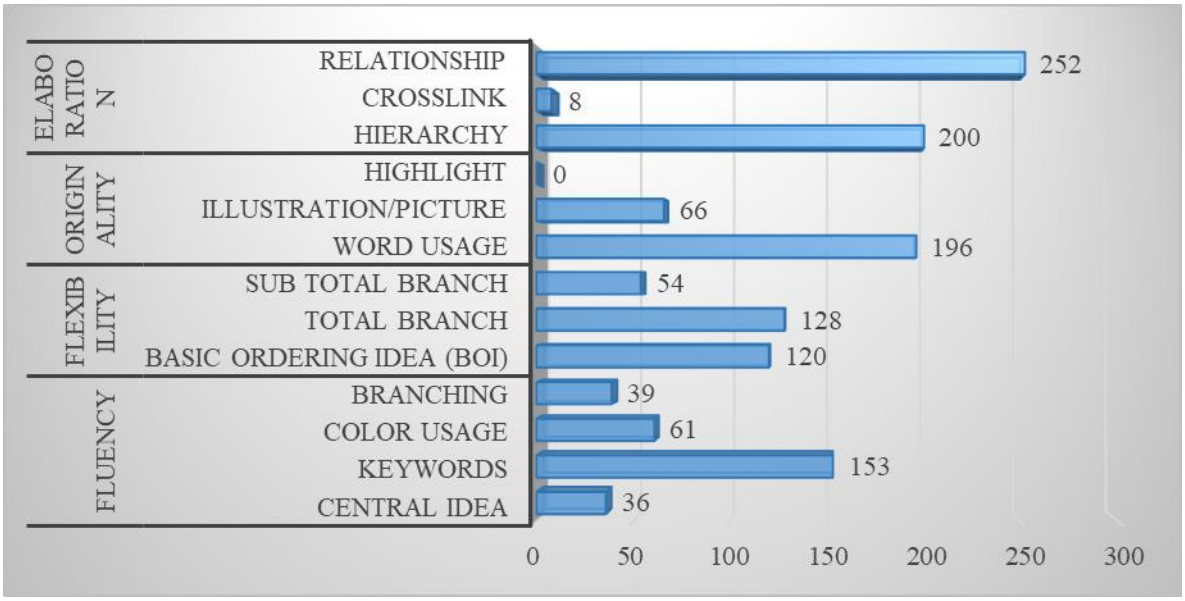

Figure 1. Comparison of Assessment of Indicators of Each Aspect of Creativity

Figure 1 shows the comparison of the results of the indicator assessment on each aspect of creativity (fluency, flexibility, originality, elaboration). Indicators in the Fluency aspect and the Flexibility aspect were met thoroughly. There was no student who did not meet every indicator assessed on this aspect. It was different from the Originality aspect and the Elaboration aspect where there was a "Highlight" indicator or "Emphasize" that was not fulfilled by the students at all and a "Crosslink" indicator that had a very minimal frequency of use.

Table 3. Results of Creativity Aspects Achievements

No.	Creativity Aspects	Achievement	Percentage (%)	Interpretation
1	*Fluency*	Achieved	46,43	*Very Fluent*
			14,29	*Fluent*
		Not Achieved	32,14	*Almost Not Fluent*
			7,14	*Not Fluent*
2	*Flexibility*	Achieved	21,43	*Very Flexible*
			21,43	*Flexible*
		Not Achieved	50	*Almost Not Flexible*
			7,14	*Not Flexible*
		Achieved	0	*Very Original*
			3,57	*Original*

3	*Originality*	Not Achieved	32,14	*Almost Not Original*
			64,29	*Not Original*
4	*Elaboration*	Achieved	0	*Very Elaborate*
			25	*Elaborate*
		Not Achieved	17,86	*Almost Not Elaborate*
			57,14	*Not Elaborate*

Overall, the creativity aspect that was mostly achieved by students was the Fluency aspect with a total percentage of 60.72%, while the lowest achievement was the Originality aspect with a total percentage of 3.57%. The total percentage of all aspects is shown in the Figure 2.

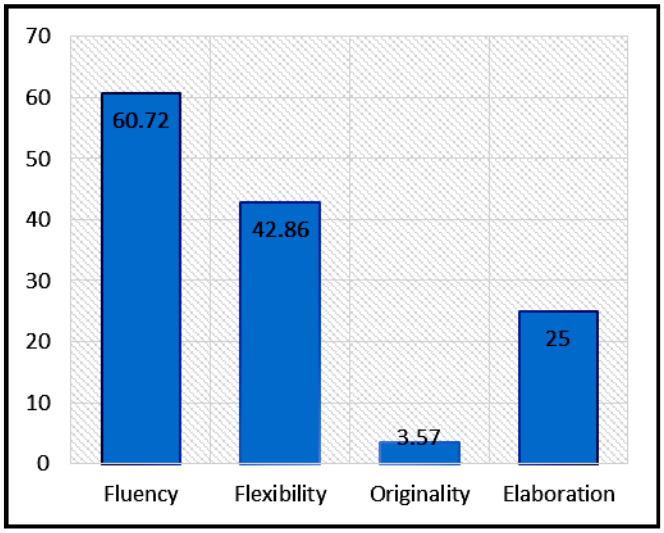

Figure 2. Comparison of Evaluation Results

The comparison of the level of creativity achievement of MI/elementary school student teachers is shown in Figure 3.

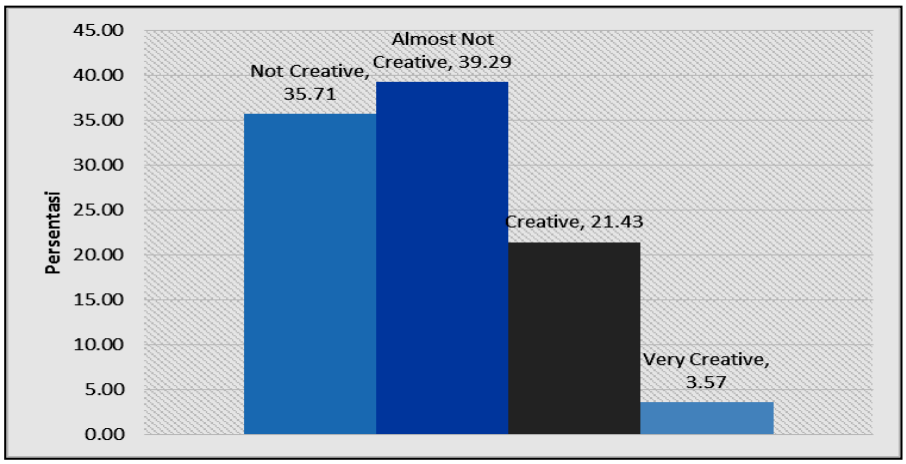

Figure 3. Comparison of Elementary School Student Teacher Creativity Levels

Figure 3 above shows that 35.71% of elementary school teacher candidates are in the non-creative category, 21.43% are in the creative category, and 3.57% are in the very creative category. However, in general, the creativity level of elementary school student teachers is in the "Almost Not Creative" category with a percentage of 39.29%.

The Misconceptions of Elementary School Student Teachers

The second aspect that becomes the focus of this research is the misconceptions of MI / elementary school student teachers. The detection of students' misconceptions was carried out by examining the results of making mind mapping.

Table 5. List of Elementary School Student Teacher Misconceptions

No.	Names	Concepts	Misconceptions	Corrections
1.	AM; AS EPL; F; FA; FS; GS; K; LI; MA; MNI; MU; NH; NK; RC; SA; S; NOH; NUK;SI	Animal Reproduction	Generative reproduction is only divided into three, namely ovipar, vivipar and ovovivipar in vertebrates	Invertebrate animals also reproduce sexually, for example in worms.
2.	NKH	Animal Reproduction	Animal reproducsction is divided into 3 types, namely ovipar, vivipar and ovovivipar.	The reproduction of living things is divided into 2 parts, namely vegetative and generative. Oviparous, viviparous and ovoviviparous are included in the division of vertebrates that reproduce sexually.
3.	BB	Plant Reproduction	Gymnosperms are pollinated by involving two sex cells, namely pollen and microfiles	The reproductive organs in Gymnosperms are strobilus. This plant involves microspores to become pollen and megaspores to become female gametophytes.
4.	F; GS; K; LI; MU; NH; NK; SA	Plant Reproduction	Describes the pollination process in generative reproduction occurring in flowers.	Not all plants are classified as complete flowers / perfect flowers. Gymnosperms do not have true flowers so it is less accurate to describe flowers that have a crown, pistil and stamens as a place for pollination in the generative breeding of seed plants.
5.	NKH	Plant	An example of natural vegetative	Grafting is an example of artificial vegetative (with

		Reproduction	propagation is grafting	human assistance)
6.	MS	Plant Reproduction	Plants that reproduce sexually are divided into two types, namely dicot plants and gymnosperms.	Seed plants that reproduce sexually are divided into two, namely Gymnosperms and Angiosperms. Angiosperms are divided into two, namely monocots and dicots.
7.	NOH	Plant Reproduction	Seed plants are divided into two, namely dicots and monocots	Seed plants that reproduce sexually are divided into two, namely Gymnosperms and Angiosperms. Angiosperms are divided into two, namely monocots and dicots.
8.	NUK	Plant Reproduction	Reproduction is divided into two, namely vegetative (artificial) and generative (natural)	Not all vegetative reproduction is included in the artificial category (human assistance), there are natural vegetative propagations such as shoots, spores, rhizomes, stagnants, tubers and so on.
9.	NKH	Human Reproduction	Description of reproduction and the characteristics of primary and secondary change	Reproduction has a different discussion than growing

Figure 4 illustrates the comparison of the sub-topic misconceptions detected by the results of making a mind map.

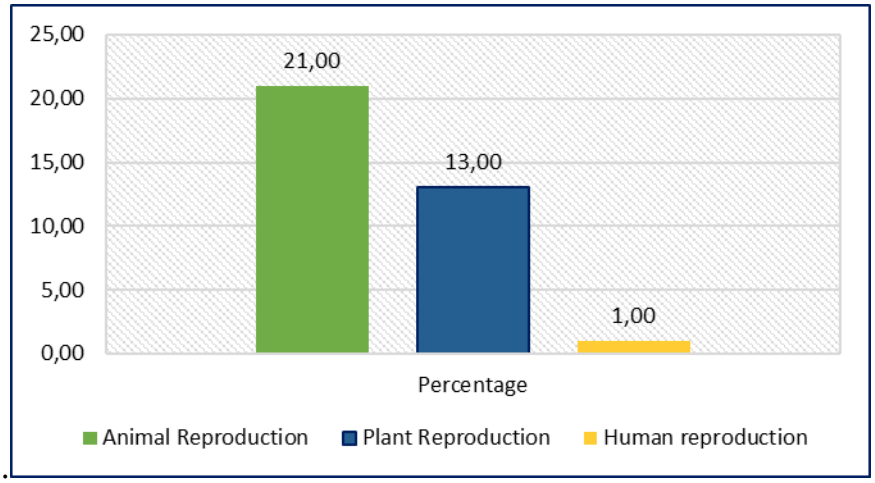

Figure 4. Comparison of the Number of Elementary School Student Teachers who have Misconceptions in Each Sub Topic

Figure 4 shows that students often experience misconceptions about animal reproduction material. The lowest misconception is found in the human reproduction material.

Assessment of creativity, especially in the concepts of Natural Sciences (Biology) requires careful instruments, especially its application in virtual classrooms during the Covid 19 Pandemic. Students need something that can stimulate their interest and enthusiasm in learning, but still do not forget the essence of concepts being taught. In learning "Reproduction of Living Things" in the study of Biological Science, the Mind Map is very possible to be used.

Sucahyanti et al. (2019) have developed a mind mapping assessment instrument to assess the concept understanding. In their research, the practicality of the Mind Map for assessing biological concepts was explained. Students gave a positive response that the Mind Map could help them understand concepts, find new ideas, and think in a more structured manner. In addition, students felt happy with the use of various colours and images in mind mapping which could increase their interest in studying biology.

The determination of student creativity, in this case MI/elementary school student teachers, was carried out using valid assessment tools. Creativity has a special correlation with divergent thinking skills, which consists of fluency, flexibility, originality and elaboration (Gralewski & Karwowski, 2019; Huang, Peng, Chen, Tseng, & Hsu, 2017). The definition of each of these thinking abilities is explained by Kampylis in H.-Y. Liu et al. (2020): fluency is the ability to generate a number of ideas related to a particular problem quickly; flexibility is the ability to generate a number of ideas as a solution to many problems; originality is the ability to produce new ideas and elaboration is the ability to expand these ideas.

The first finding based on the results shown in the diagram in Figure 2 is that of the four types of aspects of creativity (fluency, flexibility, originality and elaboration), the highest level of achievement was on the aspect of fluency with a percentage of 60.72%, while the lowest level of achievement was on the originality aspect with a percentage of 3.57%. This indicated that the students were able to generate ideas quickly because of the making of the Mind Map. They had no problem finding central ideas and making key words related to reproduction (such as generative, vegetative, natural vegetative, artificial vegetative, pollination, growth, development and so on). They were also able to create effective branching by combining different colours at different levels of the hierarchy. Unfortunately, in terms of originality, none of the students was included in the "Very Original" category. The reason was due to the minimal use of images in the Mind Map made by the students. None of

the students provided “Highlights” or emphasized concepts that needed further attention on the mind maps they created.

These results are similar to Tran et al. (2017) in developing assessment criteria for teacher creativity that concluded that the target of achieving the highest criteria was achieved by fluency, while the aspect with the most unsatisfactory results was originality. Fatmawati (2014) revealed that the tendency of low scores in the originality section was because it was the first time the new students used the Mind Map, so they were not able to bring up a lot of novelty in the maps they made.

Referring to the diagram shown in Figure 1, it is shown that the highlights by students, as part of the originality of the Mind Map, was not used at all. They did not emphasize concepts that needed further attention and exploration. The students also did not use images thoroughly as they were too focused on the use of key words. In addition to the originality aspect, the elaboration aspect also gained a minimal score, which was only 25%. None of the students reached the "very elaborate" category as in the aspect of originality. The indicator that was not achieved in this aspect was the cross link. There were only two mind maps that connected one concept to another concept in different branches or sub-branches.

The same finding was also explained by Nikmah (2017) who developed an instrument for creative thinking skills and found that the difficulty level of the instrument he made in the originality aspect was in the "difficult" category, while the other three aspects had a "sufficient" difficulty level. This indicates that the assessment related to originality still requires special attention and further development. In line with this, Rahayu et al. (2018) who conducted trials on the rubric for assessing creative thinking skills with a Mind Map (the same rubric used in this study), also found that the original level was always in the "Not Original" category and the level of elaboration was always at category “Almost Not Elaborate” that further affected the interpretation of creative thinking skills.

Figure 3 describes the results of the analysis of the creativity of student teachers in this study based on aspects of fluency, flexibility, originality and elaboration. Referring to the table, it is shown that most of them are in the “Almost Not Creative” category (39.29%). It means that on average, student teachers master at least one type of the four aspects of creativity. This is not surprising because the Mind Map has the ability to increase the students’ self-efficacy (Wette, 2017), and the students' self-efficacy has a high enough correlation with creativity (P. C. Putra & Pratitis, 2014). The aspect that has the least influence on the creativity of MI/elementary school student teachers based on the diagram

shown in Figure 2 is originality. Originality in making the Mind Map needs to be further improved so that the students can create and concoct new ideas in their mind maps.

Misconceptions can be interpreted as a situation where a concept is not in accordance with the scientific understanding agreed upon by experts or those who are competent in the field. The causes can come from teachers, students, learning resources (books), teaching methods, and the context in learning (Suparno, 2013). Misconceptions originating from the teachers should be avoided as much as possible. This requires prevention from the beginning, which in this case is to detect misconceptions experienced by student teachers before they teach in school. Misconceptions are an aspect that must be considered in science learning. Errors in understanding the concept of science are very likely to be found in students (Hajiriah, Mursali, & Dharmawibawa, 2019; Ratna & Afidah, 2020; Rolahnoviza, 2017) and even science teachers (Wijayanti et al., 2017). A very high level of misconception was found by Galvin et al. (2015) on teachers and pre-service students in biology (respiration and photosynthesis). These mistakes should be avoided and even eliminated so that a person could obtain scientific knowledge accurately. It is because the misconceptions that occur in student teachers will affect the delivery of concepts when they become teachers later (Hasyim, Suwono, & Susilo, 2018).

The same was also found by Yates & Marek (2014) in other science concepts such as evolutionary material. Misconceptions cause difficulty for students to know concepts scientifically. It becomes the barrier for them to master certain concepts. This indicates that the science subject has a large number of potential misconceptions. Research on misconceptions (since the 1990s) is very important to do as a step to detect the students' basic mistakes as well as to determine the appropriate learning strategies (Maskiewicz & Lineback, 2013). In this study, the focus of the researchers is the concept of the reproduction of living things. The diagram in Figure 4 shows that misconceptions occur in the three sub-materials of reproduction of living things (humans, animals and plants). However, the highest frequency of misconceptions was found in the Animal Reproduction sub-material.

In the Plant Reproduction material in table 5, misconceptions were found in the concept of natural vegetative propagation of plants, generative reproduction of plants, pollination and the process of reproduction in seed plants. In other words, misconceptions occured almost evenly in every indicator related to plant propagation. The same was also found by Uriyaha & Nurimanb (2018) at the elementary school level. In their research, there were student misconceptions on all the questions that represented indicators on plant reproduction. In this study, the most errors were found in the description of the perfect flower. These errors can be

caused by various things. One of which is the reading source. Students are given the freedom to add mind map making materials apart from the material given in virtual classrooms (Google Classroom). There is a big chance that the sources they use are irrelevant or invalid. In fact, not all of the science books circulating in schools are free from misconceptions. Muhidin (2018) conducted an investigation on Plant Reproduction material in the Science Book of Grade VI at the elementary school level and found misconceptions related to the concept of natural vegetative propagation, flower type classification, and pollination classification.

In addition to invalid reading sources, misconceptions can also be caused by the students' learning process, the learning methods used, and the students' sub-optimal information seeking (Samiha et al., 2017). Virtual learning systems can be the cause of students' lack of understanding due to the limited direct interaction between students and teachers (Cojocariu, Lazar, Nedeff, & Lazar, 2014). The number of complaints from students regarding internet quotas and the very limited time to work on mind maps also contributed to misconceptions in learning. As long as school from home was imposed due to the pandemic, they had to work on a number of tasks from different subjects at almost the same time.

Suparno (2013) distinguishes the types of causes of misconceptions that come from students into several parts, namely students' initial concepts, associative thinking, learning interests, student abilities, cognitive development stages, intuitive errors, wrong reasoning or generalization errors, and humanistic thinking. In addition to the learning resources and learning methods that have been previously mentioned, the causes of student misconceptions should be explained so as to prevent misconceptions. Misconceptions of sexual reproduction only occured in the topic of vertebrate animals. This was because students made generalizations and relied on the associative thinking that invertebrates all reproduce asexually. The reason was that most of the examples they found in books or other reading sources only mentioned the categories of oviparous, viviparous, and ovoviviparous animals which all exemplified vertebrates. There were also participants who relied on the intuitive thinking that "all animals can be categorized as oviparous, viviparous and ovoviviparous". This was also related to the initial ability of students who were still stagnant in their initial knowledge that animals only reproduce in these three ways.

Table 5 shows the misconceptions on plant propagation. From the table, it is explained that Gymnosperms are pollinated by involving two sex cells, namely pollen and microfiles "which is due to incomplete reasoning." Students did not yet fully understand the process of pollination and fertilization in open seed plants, so they drew partial conclusions.

Misconceptions regarding "the pollination process in generative reproduction occured in flowers" indicated by the use of complete flower pictures and misconceptions regarding "division of seed plants". The cause of this misconception was due to generalization errors and the students' initial abilities. The flower they meant was a complete flower so that the description of the flowers owned by all types of plants was the same. Their knowledge wasis still influenced by the preconception that the definition of a flower was something that had a pistil, stamens, crowns and petals. Likewise, the same also happened on seed plants where students were only familiar with dicots and monocots and were not familiar with the terms angiosperms or gymnosperms. Misconceptions in reproduction material are quite common, both in plant and human reproduction (Hairy, Kusmiyati, & Yamin, 2018; Uriyaha & Nuriman, 2018). The advantage of using the Mind Map as an evaluation tool is that it can trace the starting point of misconceptions and which parts are safe from misconceptions. This is usually difficult to reveal when measured using other instruments such as tests or questionnaires. However, the limitation of this instrument is that not all science materials can use this evaluation tool. It takes a complex concept with a number of ramifications of material so that students can flexibly develop their mind mapping.

CONCLUSION

Based on the results of the study, it was found that in general the level of creativity of MI/elementary school student teachers is in the “Almost Not Creative” category with a percentage of 39.29%. It means that on average each student only mastered one to two aspects of creativity. Meanwhile, elementary school student teachers still experienced misconceptions. The most common misconception was in the Animal Reproduction sub-material. In this study, the causes of misconceptions came from references, the learning process, students' initial concepts, associative thinking, interest in learning, intuitive errors, wrong reasoning or generalization errors, and humanistic thinking.

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