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The analysis of pedagogic competency of the students of primary teacher education at Musamus University in designing environmental-based instructional media

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Abstract. Teachers are at the spearhead of the education system. One of the compulsory skills for the teachers to master is the ability to create instructional media. The instructional media might be obtained from the environment or the usage of ICT. The objective of this research was to determine the abilities of prospective elementary school teachers in designing and composing environment-based instructional media for natural science subjects. The present research was conducted at Musamus University Merauke with a sample of 34 students. It was included as descriptive research, while the data were collected using observation and documentation techniques. The results show that 61.8% of the students have been able to design and prepare environment-based instructional media for natural science subjects. One of the factors that encourage the students to design and prepare the media is the situation and condition of their area of origin. As for the students who have not been able to design and prepare environment-based instructional media, it results from their lack of understanding on the learning materials. This, therefore, only makes them think practically: using the ICT-based media without any consideration that they are going to be prospective educational devotees in the remote areas. However, they are still equipped with ICT-based learning according to current technological developments.

1. Introduction

Teachers are at the spearhead of the education system. It is due to the very important role of the teachers in the learning process while interacting with the learners. A teacher must be able to be a motivator, encouraging the learners to study hard. Also, a teacher should be able to assist the learners in the learning process. Therefore, the teacher can turn from a major player into a companion in the learning process [1].

The teacher is a profession, meaning a position that requires special skills as a teacher and cannot be done by anyone outside the field of education [2]. There are four main competencies that must be mastered by a teacher: pedagogic competence, personal competence, professional competence, and social competence [3]. A teacher is called a competent teacher if he/ she have met all four teacher competencies. Competent teachers will have better performance in creating an effective & fun learning environment and managing the class, thus allowing the learners to learn at an optimal level [4].

Pedagogic competence is competence related to teacher ability in managing the learning process [3]. A teacher is considered to have pedagogical competence if he/ she can meet these competency



indicators. One of the required capabilities in pedagogic competence is the ability to design, prepare and develop instructional media. A teacher is expected to be capable of using the tools or materials that support the learning process, starting from simple tools to the sophisticated ones (according to the development and demands of the era) [5].

Instructional media consist of different types of components within the learners' environment which can give stimulations for them to learn [6]. The availability of instructional media is expected to facilitate the interaction between the teachers, learners, and learning resources. The instructional media have a function to explain some things that the learning programs have difficulties to explain verbally [7].

Natural science subject is one of the subjects that must be taught at the elementary education level. Natural science examines the natural phenomena which are included as a set of generally accepted observations and experiments [8]. Experiments that have become one of the scientific methods in the development of sciences (physics, chemistry, and biology) contribute to a huge impact on technological developments as they are today. For example, the discovery of smartphone technology is one application from the development of physical and chemical technology. Therefore, natural science learning in elementary school is very important to teach as a basic provision for the students' learning process at a higher level.

Current technological developments are very helpful for teachers in teaching and learning process, especially on natural science subjects. For example, a teacher can teach atomic structure in details, via animation or image media. It is one of the advantages of Information and Communication Technology (ICT)-based media, which is capable of turning abstract concepts into the concrete ones, using static and dynamic (animation) visualization [9]. Also, the instructional media also help provide a learning experience that is difficult to obtain in other ways [10].

However, how can we properly teach natural science subjects in the ICT-unreachable areas? It is certainly a challenge for teachers to teach natural science subjects easily, as is done in ICT-unreachable areas. One of the best solutions to teaching natural science in remote areas is to utilize the natural environment as an instructional media. The natural environment is a very effective instructional media in science learning. The utilization of natural resources found in the surrounding environment will make the learning process more meaningful, while on the other hand, the memories of the learners will last longer since they are directly involved with the lesson materials [11].

The students of Primary School Teacher Education (PGSD) at Musamus University (Unmus) are potential teachers who will serve in Papua, especially in the South of Papua. As prospective teachers, they must be prepared to deal with the limited learning situation and condition, particularly in the remote areas. It is certainly not a reason for them to stay away from ICT-based learning, as they must be prepared to deal with the very limited learning condition. The researcher, therefore, would like to find out the extent of their abilities in designing and developing environment-based instructional media for the learning process. It is done so that they can be equipped with adequate skills through related subjects, such as natural science subjects for elementary schools, natural science learning innovation, natural science instructional media, and the development of natural science's teaching materials.

2. Material and Method

The population of this research was the sixth-semester PGSD students, consisting of 3 classes, namely classes A, B, and C, with 91 active students. The sampling was performed using purposive sampling method, namely the sampling done by direct selection. The class used as the sample was class C consisted of 34 people. The sample selection was based on the consideration that the majority of the students in that class are native Papuans, as many as 74% or 25 people.

The type of this research was descriptive. The data collection was carried out through observation and documentation techniques. The observation technique was done through the observation of the presentation of instructional media designed according to the pre-distributed materials. The

documentation technique is done through data collection on the students' ability in determining and designing instructional media.

3. Results and discussion

Materials in natural science for elementary schools provided to the students are adapted to the subject contained in the Education Content Standards Number 21 of 2017 [Regulation of Minister of Education and Culture, 2016]. The standards of the content include 22 items presented in the table (1). The scope of natural science's material in Table (1) can be simplified into four main natural science subject groups taught in elementary schools. This grouping is based on the material review of the overall subjects presented in the natural science subjects for elementary schools. The four groups of materials are presented in table 1, with the subjects simplified into 15.

Table 1. First to Sixth Grade for Natural Science Subjects

No	Lesson Subject
1	Body and Five Senses
2	Plants and Animals
3	Properties and Shapes of Surrounding Objects
4	The Universe and its Appearance
5	Outer Shape of Animals and Plant Body
6	Life Cycle of Living Beings
7	Plant Propagation
8	The Shape of Objects
9	Force and Motion
10	Forms and Resources of Energy and Alternative Energy
11	Earth's Appearance and its Changes
12	Environment, The Universe and Natural Resources
13	Climate and Weather
14	Skeleton and Organs of Animals and Human
15	Food, Food Chain, and Ecosystem Balance
16	Reproduction of Living Things
17	Adaptation of Living Things to Environment
18	Health and Human Respiratory System
19	Changes and Properties of Objects
20	Electrical and Magnetic Heat Transfers
21	Solar System
22	Mixture and Solution

Source: [12]

Table 2. Material Group of Natural Science Subjects for Elementary Schools

No	Material Group	Scope of Material	Number of Students
1	Living Beings and the Process of Life	1.1. Plants and Animals	3 people
		1.2. Life Cycle of Living Beings	3 people
		1.3. Skeleton and Organs of Animals and Human	3 people
		1.4. Food, Food Chain, and Ecosystem Balance	3people
		1.5. Reproduction of Living Things	2people
		1.6. Adaptation of Living Things to Environment	2people

2	Objects and its Properties	2.7. Properties and Shapes of Surrounding Objects	2people
		2.8. Electrical and Magnetic Heat Transfers	2people
3	Energy and its Changes	2.9. Mixture and Solution	2people
		3.10. Force and Motion	2people
		3.11. Forms and Resources of Energy and Alternative Energy	2people
4	Earth and the Universe	4.12. The Universe and its Appearance	2people
		4.13. Environment, The Universe and Natural Resources	2people
		4.14. Climate and Weather	2people
		4.15. Solar System	2people

The observation and analysis results conducted on the students' task on the determination and design of instructional media according on table 2 are presented in table 3.

Table 3. Determination and Planning of Instructional media of Natural Science Subjects for Elementary Schools

Lesson Subject	Type of Media			Number of Student (People)
	Environment-based	Number of Student (People)	Other media	
Plants and Animals	Plants and Animals around classroom/ school	1	- PowerPoint media containing images of plants and animals - Using photos of animals and plants glued on Styrofoam	2
Life Cycles of Living Beings	Using animals around the classroom, such as frogs, chickens, and cockroaches	2	Images of the animal life cycle glued to Styrofoam, such as frog's life cycle	1
Skeleton and Organs of Animals and Human		-	Human torso and organs	3
Food, Food Chain, and Ecosystem Balance	Bringing the learners to the school yard to see insects or caterpillars eating leaves, those edible for chickens.	2	Using images found in a particular ecosystem	1
Reproduction of Living Things	- Generative reproduction in animals: showing	2		-

Lesson Subject	Type of Media			Number of Student (People)
	Environment-based	Number of Student (People)	Other media	
Adaptation of Living Things to Environment	chickens and eggs or chicks			
	- Generative propagation in plants: showing flowers - Natural vegetative propagation: showing banana buds - Artificial vegetative propagation: transplanting a mango tree	1	Photos of several animals and plants, such as ducks, bird beaks, camels, tigers, cactus, teak trees	1
Properties and Shapes of Surrounding Objects	- Solid, liquid and gaseous objects may be shown in the class, such as markers or lime for solids, water for liquids, and air for gaseous objects - One of the properties of liquids can be shown by bringing the learners to a stream of water flowing down a hill	2		-
Electrical and Magnetic Heat Transfers	Showing the sun's heat by drying a piece of cloth under the sun for several minutes	1	Using animated media and images	1
Mixture and Solution	- Using a mixture of water and sand, water and soil - using salt and water solution	2		-
Force and Motion	Doing tug of war on the schoolyard	1	Showing photos of children pushing the motorbike onwards	1
Forms and	- Showing examples of	1	Bringing props,	1

Lesson Subject	Type of Media			Number of Student (People)
	Environment-based	Number of Student (People)	Other media	
Resources of Energy and Alternative Energy	energy sources, the such as sun, water, wind - Example of changes in motion energy into heat energy: a string rubbed on a dry wood can produce fire		such as flashlight, iron, mini fan	
The Universe and its Appearance	Bringing the learners around the school to see the lowlands, hills, mountains	2		-
Environment, The Universe and Natural Resources	- Showing examples of renewable natural resources, such as water, wind, sun - Showing an example of non-renewable natural resources: metal	2		-
Climate and Weather	Showing examples of weather during learning, such as gray, rainy, cloudy weather, etc.	2		-
The Solar System			- Using a simulation of solar system - Showing plane images to the learners.	2

Table 3 shows that some lesson subjects might use environment-based media and other media, such as images, PowerPoint, videos, animations, and simulations. These lesson subjects are included, but with exception of materials that the students cannot present using environment-based media, for example, the solar system lesson subject.

3.1. Lesson Topics that can use Environment-based Media and Other Media

Based on Table (3), it is found that the number of lesson subjects that can make use of environment-based media and other media, such as pictures, video, animation, and simulations, is 7 in total, or 47% of the total natural science subjects for elementary schools. The number of the students who consider that these lesson subjects can use environmental media or other media is 17 in total or 50% of the total students. Judging from the lesson subjects, this number is very reasonable. For example, in plant and animal lesson material, the students chose environment-based media, considering it was more easily available in ICT-unreachable remote areas. As for the students who chose other media, they thought they preferred these media, such as pictures, videos or others, because it did not occur to them that

animals or plants could be used as instructional media. Also, a major factor that made students do not choose environmental media was the lack of understanding of the study materials.

3.2. *Lesson Subjects that use Environment-based Media only*

There are 6 materials that the students consider to be the subjects which can only use environment-based media. The lesson subjects are the Reproduction of Living Beings; Properties and Shapes of Surrounding Objects; Mixture and Solution, The Universe and its Appearance, Environment, The Universe and Natural Resources, and Climate and Weather. The number of these materials is slightly smaller than that of the lesson subjects which can use all media at 40%. The number of students who designed and developed the media with this material is 12 in total or 35% of the total students.

The students who chose this media considered that these materials were very suitable if being taught using environment-based media. For instance, on the reproduction of living beings, the students designed some environment-based media at the time of learning. For the animals' generative reproduction, they showed mother hens and egg or chicks. For generative plants' propagation, they showed flowers with pistils and pollen heads. For natural vegetative propagation, they showed banana shoots. For artificial vegetative propagation, they did grafting and cuttings. It demonstrates that the students who choose these media have mastered the material for teaching. It is in contrast to the students saying that the lesson subject can use all media. In this section, the students know if the lesson subjects can use other media, even those which are based on ICT. Nevertheless, the students realize that it is still difficult for ICT to reach the learning process in the remote areas of Papua.

3.3. *Lesson Subjects that cannot use Environment as Instructional Media*

The lesson subjects on Skeleton and Organs of Animals and Human and Solar System are two subjects that cannot be taught by the students using environmental media. The students considered that the lesson subjects on Skeleton and Organs of Animals and Human could only be taught through images, torso visual aid, or ICT media. For example, when discussing the circulatory system, the students could not explain it using environmental media. Therefore, this material was considered difficult to teach in the rural areas. In fact, if the students thought more creatively, they could still use the floor to describe the circulatory system, such as circulation of large and small blood. Furthermore, the teachers can demonstrate large and small blood circulation by walking on the image, according to the direction of the basic circulation.

The students also considered that the solar system was the most difficult material to be taught. It was because the only usable media was ICT-based media. According to the students, solar system learning would become easier if it used a simulation of celestial bodies revolving the sun. However, this simulation could not be used in schools in rural areas. Therefore, the students as prospective teachers should be able to think to find alternative instructional media, such as making the learners as learning media for simulation of the solar system. It could be done by asking the learners to act as the sun, mercury, and other planets.

Both of these lesson subjects are rather difficult to teach using environmental media. However, if students thought more creatively, they would surely find other media as a solution. Another factor that made students cannot find environmental media (e.g., for solar system materials) was the student's lack of understanding on the material. For instance, it happened when the students were asked to simulate earth and moon revolving around the sun, they collided with each other, as they were confused with the movement and direction of each rotation. This is what proves their inability to make the environment as instructional media. It is not because the material cannot be taught through environmental media; instead, their lack of understanding is the thing that becomes another causal factor

4. Conclusion

Environmental-based instructional media are very suitable to be used in schools in remote areas unreached by the ICT. 21 people or 61.8% of PGSD students as prospective natural science teachers have been able to determine and design an environment-based instructional media. One of the factors encouraging the students to design and construct environment-based media is the condition and circumstance of their hometown

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