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Natural Science Learning Based on Technology For Students to Prepare For 4.0-Era Education

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Abstract— **College Students of Primary School Teacher Education, Ahmad Dahlan University are the younger generation who will contribute in building civilization in education, especially after they graduate and apply knowledge in the elementary school world. For this reason, lecturers need to provide knowledge in accordance with the educational development in the 4.0 era. The education world that will enter the industrial era 4.0 means that lecturers must prepare college students to be more literate in technology, so that later when they go to the school world they can teach with good technology. The way the lecturers prepare students is by doing the SETS (science, environment, technology, and society) approach in learning, natural science learning with online modules, doing IT training for college students, and WhatsApp online classes.**

Keywords— **natural science learning, technology, era 4.0**

I. INTRODUCTION

Education is an important thing in human life. Education is the main foundation in managing, printing, and improving high-quality human resources [1]. One of the education form that can be taken is through university courses. Ahmad Dahlan University, especially the Primary School Teacher Education Study Program has a Natural Science course. The Natural Science course is very important because there are many things that can be learned about everyday life and the surrounding environment.

Natural Science has three dimensions, which are processes, scientific attitudes, and products. The processes in Natural Science can be done through learning, as well as observations and research in natural environment. Science process skill have been described as mental and physical abilities and competencies which serve as tool needed for the effective study of science and technology as well as problem-solving, individual and societal development [2]. The scientific attitudes of Natural Science are curiosity, an open attitude towards new discoveries, and experimentation. One of the products of Natural Science is technology, therefore Natural Science is closely related to technology. Especially now in the 21st century where technology is developing fastly. Lecturers and college-students must be mastering the technology so as not be outdated. The present tertiary students aged between 18 to 23 years old and they belong to the Generation -Z (Gen Z) who are so revolutionized by technology. The learning preference of the Gen Z students is different students from the previous generation as they are more hands-on and directly involved in the learning process. [3].

People call the Nowadays Technology development era as the 4.0 era or industrial revolution. Industrial Revolution emerged many improvements in manufacturing and service systems. Because of remarkable and rapid changes appeared in manufacturing and information technology, synergy aroused from the integration of the advancements in information technology, services and manufacturing were realized 4]. The academics, such as lecturers and college-students must understand it well, even following the 4.0 era. The educational challenge in the industrial revolution 4.0 era are changes in students' way of learning, thinking patterns, and ways of acting in developing creative innovations in various fields. The future of education is more important to know why you need something, built around each individual, their personal choice of where and how to learn, and tracking of performance through data-based customization,and learning together and from each other – peer to peer learning will dominate, teachers more as facilitators, of communities built around shared learning and aspiration [5]. For this reason, it is important to prepare the college-students to become an important part of 4.0 era. There are several ways that lecturers can do in preparing college-students to face 4.0 era, including learning SETS (science, environment, technology, and society) approach in learning, science learning with online modules, doing IT training for college-students, and WhatsApp online classes.

II. METHOD

The method used in this paper was literature review, by carried out theoretical studies on the relevant research, journals, and books. This research started from studying Natural Science learning, technology, 4.0 era, STE approach in science learning, and online modules. Then formulated a concept on how to prepare students to face 4.0 era. Data analysis techniques were carried out by evaluating and reflecting on the results of theoretical studies and relevant research.

III. DISCUSSION

A. Natural Science Learning

Natural Sciences is a science that studies about the natural environment and its contents, which are all objects that exist in nature, also events and symptoms that appear in

nature [6]. Natural Science is related to natural phenomena systematically, therefore Natural Sciences is one of the subjects that must be studied in the Primary School Teacher Education Program. The processes in science learning can be done by emphasizing the provision of direct experience and through technology-based learning media in order to develop college-students' competencies in understanding the nature scientifically. Based on the explanation above, it needs a process of Natural Sciences learning that is relevant to life because Natural Sciences lessons are very closely related to life.

The main aspect in Natural Sciences learning is to be able to arouse curiosity to explore new knowledge, and then apply it in life based on information that has been learned [7]. This cannot be separated from the duties and responsibilities of lecturers to equipped college-students with knowledge that can be applied in their lives.

B. Technology in learning

The rapid development of technology in the current era of globalization is affecting the educational world. The global era has demanded the education world to adapt to technological developments in improving the quality of education. In education world, it aims to make college-students understand technological tools in general so that they can easily get information.

The roles of technology in learning are to help the learning process, it also has a quite influential role for educators, especially in the utilization of facilities in their teaching abilities [8]. Therefore, all educational technologies that have been produced must be selected and designed based on the need analysis of the specific educational environment. In determining the technology for learning, it must understand the system that will be used. All these elements must be fulfilled so that the learning goals can be achieved.

C. 4.0 era in education

The era of the Industrial Revolution 4.0 has had an impact on lives, including the education. The 4.0 era is marked by the central role of cyber technology in life. Therefore, in the education world the term of "Education 4.0 " has emerged.

Education 4.0 is a general term used by experts to describe various ways to integrate cyber technology, both physically and non-physically, into learning. Education 4.0 is a phenomenon that responded to the need for the emergence of a fourth industrial revolution in which humans and machines are aligned to find solutions, solve problems, and of course find the possibility of new innovations [9]. To support Education 4.0, it is necessary to have certain competencies. Competencies needed in the Education 4.0 era are :

a. First, critical thinking and problem-solving skills. In this case the lecturers must be able to design learning so that they can explore the college- students' competencies.

b. Second, communication and collaborative skills. Technology-based learning models need to be applied by lecturers in order to construct communication and collaborative competencies.

c. Third, creativity and innovative skills. In the 4.0 era, it is required to think critically and innovatively so that college-students can compete and create employment based on Industry 4.0.

d. Fourth, information and communication technology literacy. Information and communication technology literacy is the basis that must be mastered by lecturers in order to be able to produce college-students who are ready to face the Industrial Revolution 4.0.

D. Natural Science learning in the 4.0 era

Lecturers must have good teaching methods in improving college-students' competencies. There are several ways to do it such as:

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a. SETS (Science, Environment, Technology, and Society) Approach

The SETS approach is a learning approach that seeks to bring students to have the ability to look at things integrally by linking the four elements of SETS so that a deeper understanding can be obtained. The knowledge that they comprehends in-depth enables them to utilize it in life according to their level of education. The focus of SETS teaching is about how to make pupils able to carry out investigations to get interrelated knowledge of science, environment, technology, and society. Asking students to conduct an investigation means giving them the opportunity to further develop the knowledge they have acquired in order to solve the problems that are expected to arise around their lives [10].

The four elements in SETS approach, science, environment, technology and society, are mutually integrated because it has become one entity so that it cannot be separated. This is in accordance with the concept of Natural Science learning which is one of the subjects that must be studied in the Primary School Teacher Education Program. Natural Science is the focus of attention in the education field. Therefore, with the SETS approach lecturers and college students can learn science associated with technological developments in the 4.0 era so that it can have a positive impact on the environment, people, and community. This is done so that the learning objectives can be fulfilled and applied in everyday life. The link between Natural Science as the focus of attention and the SETS elements can be seen in Figure 1.
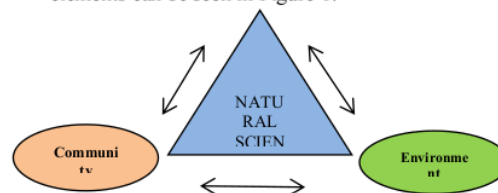

Fig. 1. The correlation of science as the center of attention and the SETS elements

The four main elements of SETS can have positive and negative effects depending on the management. When college-students can link the four elements, they will always think of the short term and long term by analyzing the conditions and collaborating new ones so that they are intended for something good to be achieved. In Natural Science learning through the SETS approach, the lecturers can direct college-students to look for positive and negative impacts that might arise due to the application of Natural Science into the form of technology. Therefore, it does not adversely affect the environment, can provide solutions, and meet the needs of surrounding communities. College-students are invited to discuss and seek better technological solutions through the SETS approach based on their initial knowledge.

"Education with SETS insight can make science and technology literate, while at the same time paying attention to the interests of the community and the health of the surrounding environment, mental, and spiritual". (Binadja,1999).

Based on the above quotation, SETS-oriented education is an educational concept that is needed in the 4.0 era because this approach collaborates between Natural Science, as a science that must be studied while being adjusted to technological developments in order to be a solution to meet people's needs, and still pay attention to the surrounding environment.

b. Natural Science learning with online module

One learning source of Natural Science courses that can be used by college-students of Primary School Teacher Education (PGSD) in Ahmad Dahlan University (UAD) is online module. Learning Natural Science with online module is an implementation of digital technology. The Digital Module with the title "ADVANCED NATURAL SCIENCE" is used as teaching material for Advanced Natural Science Course for college-students of PGSD UAD in their second semester.

In this digital module, there contains explanation of Course Descriptions, Initial Ability Tests, Module's Instructions Guide, Learning Activities 1, Learning Activities 2, Learning Activities 3, and Learning Activities 4. The learning material contained the Digital Module of Natural Science Learning can be seen in table 1.

TABLE I.   MATERIAL OF ADVANCED NATURAL SCIENCE

MATERIAL OF ADVANCED NATURAL SCIENCE	PAGE
LEARNING ACTIVITIES 1	
Identifying the structure and function of the plant tissue	2
Describing the process of obtaining nutrients and transforming energy in green plants	12
Identifying the kinds of movements in plants	18

Identifying pests and diseases in plant organs that found in everyday life	27
EVALUATION TEST	43
BIBLIOGRAPHY	44
LEARNING ACTIVITIES 2	
Describing the excretion system in human and its correlation with health	45
Describing the reproductive system and diseases related to the reproductive system in human	74
Describing the coordination and sensory system in human and its relationship with health	96
EVALUATION TEST	199
BIBLIOGRAPHY	120
LEARNING ACTIVITIES 3	
Defining the notion of biotechnology	121
Describing the benefits of using biotechnology in food production	124
Making simple biotechnology products that can be used in everyday life (tempeh, fruit juice fermentation, hydroponic and aeroponic system)	139
BIBLIOGRAPHY	139
LEARNING ACTIVITIES 4	
Identifying the types of force, the sum of force, and force effects on objects	146
Applying Newton's law to explain various events in everyday life.	154
Explaining the correlation between the form of energy and its changes, the principle of "Work and Energy" and its application in daily life.	183
Showing the use of several simple appliances.	160
Resolving simple problems related to simple appliances quantitatively.	195
BIBLIOGRAPHY	199
LEARNING ACTIVITIES 5	200

The Digital Module of Natural Science Learning is made referring to the main purpose of equipping prospective elementary school teachers with knowledge. The module was prepared by PGSD UAD lecturers namely Ika Maryani, M. Pd. and Siwi Purwanti, M.Pd. who teach related subject. The Module of Natural Science Learning can be downloaded at the following link https://drive.google.com/file/d/1jMEpeXocsWblL_3pjm2YmfcZq33TywT8/view?usp=sharing

c. Conducting IT Training for College-Students

Ahmad Dahlan University has a mandatory training program for all new students conducted by the Bureau of Student and Alumni (BIMAWA). The programs that must be followed by new students are the English language training, the introduction of UAD's academic information system, and soft skills training. All the

trainings are carried out according to the schedule and place set by BIMAWA [14]. In the introduction of UAD academic information system program, students will be given IT training in the form of E-Learning Training.

After being registered as a UAD student, students will receive a training card. E-Learning Training is held at the 3rd/4th Floor of the ITC Building, Campus I UAD Jl. Kapas 9 Semaki. In order to find out information about the training, new students must look for it on the online announcement in the BIMAWA UAD website.

Lectures process at UAD are based on IT and utilize E-Learning. Therefore, the information system training program for new students is important so that in the future students will no longer be confused and can immediately follow E-Learning, thus learning is more interactive.

In E-Learning training, there is webmail and hotspot. Students are guided directly by expert staff in making an account, how to use it, the benefits of E-Learning, how to download material, send assignments, how to access various simeru websites, portals, and various other important information related to the lecture system which will later be needed during courses.

d. Online WhatsApp Class

The implementation of ICT as a learning media is thought to have been able to create an effective learning atmosphere because it provides better and faster learning opportunities for students. It contains learning material and assignments, also guidance discussions between students and teachers can be done outside formal teaching hours. Many applications developed based on mobile phones and web. One of the most developed and popular applications now is WhatsApp (Prajana, Andika 2017).

According to the research done by Prajana which was published through journal on 2017 regarding the design of E-Learning through the WhatsApp application, the following are types of WhatsApp contents that can be used in online classes:

1) Group Chat content can be used for integration between lecturers and students in a real time.
2) Share Document content can be used to help study groups in sending file documents.
3) Camera content is used to divide several activities that require pictures taken on an activity.
4) Gallery content is used to share or send previously stored pictures/videos.
5) Audio content is used to divide sound files.
6) YouTube Video Box Application used to share collections and share videos on WhatsApp.
7) Dropbox Applications used for sharing lecture files [15].

During teaching and learning activities, there are several problems that often occur when lecture take

place, one of which is limited space and time. In this case, the lecturers cannot meet face-to-face with their students or students want to hold guidance while the lecturer is out of town. With the WhatsApp application, they can hold an online class where lecturers can still deliver learning material, giving assignments, and having communication through online classes.

IV. CONCLUSION

Based on the results of the research that has been done, it can be concluded that learning Natural Science in the 4.0 era can be realized through learning SETS (science, environment, technology, and society) approaches in learning, science learning with online modules, doing IT training for college students, and WhatsApp online classes.

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