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Analysis of Students' Initial Ability in Biopolymer Material

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ABSTRAK

Penelitian ini bertujuan untuk mengidentifikasi kemampuan awal mahasiswa pada materi biopolimer sebagai dasar untuk mengembangkan desain pembelajaran. Penelitian ini menggunakan metode analisis konten, dengan partisipan mahasiswa semester IV di salah satu program studi Pendidikan Kimia, Universitas negeri di Jawa Barat. Instrumen yang digunakan dalam penelitian ini adalah test uraian yang terdiri dari 13 pertanyaan. Hasil analisis data kemampuan awal menunjukan bahwa secara keseluruhan teridentifikasi sebanyak 41% mahasiswa memiliki kemampuan awal dengan kategori cukup, 33% mahasiswa dengan kategori buruk, 23% mahasiswa dengan kategori bagus dan 3% mahasiswa memiliki kemampuan awal dengan kategori sangat bagus. Berdasarkan temuan tersebut, terdapat beberapa intervensi yang cocok dijadikan acuan dalam mengembangkan desain didaktis, seperti menampilkan video pembelajaran terkait pembuatan bioplastik sederhana, grafik perkembangan dan pembiayaan produksi tahunan bioplastik, gambar-gambar dari aplikasi bioplastik dalam berbagai bidang serta infografis terkait proses penguraian dan manfaat keberlajutan dari bioplastik.
Keyword: **Kemampuan Awal; Desain Pembelajaran; Biopolimer**

ABSTRACT

This study aims to identify students' initial abilities in biopolymer materials as a basis for developing learning designs. This study uses a content analysis method, with participants being fourth-semester students in one of the Chemistry Education study programs, at a state university in West Java. The instrument used in this study was a descriptive test consisting of 13 questions. The results of the Initial ability data analysis showed that overall, it was identified that 41% of students had an Initial ability understanding with a sufficient category, 33% of students had a poor category, 23% of students had a good category and 3% of students had an initial ability understanding with an outstanding category. Based on these findings, several interventions are suitable as references in developing didactic designs, such as displaying learning videos related to the manufacture of simple bioplastics, graphs of development and annual production costs of bioplastics, images of bioplastic applications in various fields, and infographics related to the decomposition process and the benefits of sustainability of bioplastics.
Keyword: Initial Ability; Learning Design; Biopolymer

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1. INTRODUCTION

Environmental problems in the 21st century have become a very serious problem, especially in the massive use of petrochemical plastics has become a real problem for the world's health and environment (Azmin et al., 2020a). This is also in accordance with the fact that Indonesia is the second largest contributor of plastic waste in the world after China (Wahyuningtyas & Suryanto, 2017; Hendar et al., 2022). According to the latest data provided by INAPLAST (Indonesian Oleafin Aromatic Plastic Industry Association), annual plastic consumption in Indonesia is estimated to reach 9.52 million tons in 2019. Indonesia has even become the 2nd largest country in the world that dumps plastic waste into the ocean, as a result of which various

environmental problems such as the accumulation of plastic waste, seawater pollution by microplastics, and can damage the animal food chain both on land and in the sea (Zoungranan et al., 2020).

The above problems cannot be escaped from the fact that the quality of the environment is highly dependent on human behavior. Environmental damage is caused by human ignorance in preserving, managing, and protecting the environment (Purba & Yunita, 2017). Therefore, developing environmentally literate residents is very important to understand and overcome environmental problems that occur (Dolenc Orbanić & Kovač, 2021). This is also supported by recommendations based on the results of the PISA survey, namely that the community must provide a healthier and safer environment for future generations through increasing awareness of issues related to environmental problems (Eren & Yaqub, 2015). Therefore, the United Nations as a world organization introduces sustainable development as an approach and is the top priority for the whole world to overcome problems that occur in the environment (Azmin et al., 2020b). Environmental education is believed to have an important role in achieving sustainable development, (Hermann & Bossle, 2020) and increasing environmental awareness (Miterianifa & Mawarni, 2024) especially if developed in universities (PT), (Mkumbachi et al., 2020) this is because students are part of sustainability and will be responsible for educating future generations (García-González et al., 2020).

The development of ESD in higher education can be applied through continuous chemistry learning. (Burmeister et al., 2012) This is because both have the same goal, which is to develop students' awareness of sustainability chemistry issues, increase science literacy in sustainability, and develop the right skills among current and future generations. (Chen et al., 2020) In addition, to apply ESD in chemistry learning, it is necessary to have learning tools that support the implementation of systematic learning, (Burmeister & Eilks, 2012) one of which is to develop ESD-oriented didactic designs.

The development of ESD-oriented didactic design in chemistry learning can be developed through courses with biopolymer sub-materials in the context of bioplastics. The use of conventional plastics and bioplastics in modern industrial societies is well suited to be used as a three-dimensional sustainability debate (ecological, economic, and social) so that this debate can be placed among scientific social issues related to chemistry learning. (Wolf et al., 2009)

One of the basics of didactic design development is the consideration of students' initial abilities. (Suryadi, 2011) Early abilities are an integral part of learning that provides a framework for assimilating new knowledge into existing cognitive structures. (Van & Tinonas Diaz, 2019a) It is very important to identify the learners' initial abilities before teaching some new content to direct the learning process. (Yang et al., 2021) There are several studies that show that early ability greatly affects student achievement. (Hailikari et al., 2008) Based on the background that has been presented, data in the form of student's initial abilities in the context of bioplastics are needed to be used to develop learning designs.

2. RESEARCH METHOD

This study uses a content analysis method, with the participation of fourth-semester students in one of the Chemistry Education study programs, at a state university in West Java. The instrument used in this study is a description test consisting of 12 questions on the cognitive process dimension. The procedure used in this study only reveals three of the four stages of the content analysis method (Fig. 1), namely *material collection, descriptive analysis,* and *category selection.*

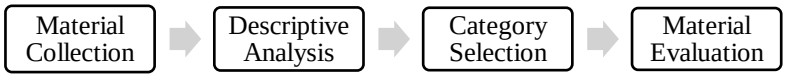

Figure 1. Content Analysis Stage in General (Mayring, n.d.)

The first stage is the collection of materials. The collection of materials can be obtained from various literature such as books and journal articles. The purpose of the *material collection* stage is to produce comprehensive definitions of the concept of biopolymers that will be used as the basis for making test instruments. (Mayring, n.d.)

In the second and third stages, namely descriptive analysis and category selection, this stage is carried out after the instrument test is tested. Data in the form of student answers that have been collected will be analyzed with percentage interpretation data processing techniques and categorized based on the answer rubric with four criteria for understanding the concept, namely 0= Bad (-); 1= Fair (+); 2= Good (++); 3= Very Good (+++). The percentage of each criterion is obtained from the formula below

$$persentase\% = \frac{Skor\ yang\ diperoleh\ (x)}{Skor\ maksimum\ (n)} \times 100\% \quad (1)$$

Then, each student's answer was analyzed to show learning obstacles that appeared in learning. The identified learning barriers are further analyzed to produce several interventions that can be used as solutions to overcome learning obstacles and can be used as a reference in compiling didactic designs at the material evaluation stage.

3. RESULTS AND DISCUSSION

One of the foundations of didactic design development is the consideration of the initial abilities of students (Suryadi, 2011) Initial ability is an integral part of learning that provides a framework for assimilating new knowledge into existing cognitive structures (Van & Tinonas Diaz, 2019a) It is very important to identify students' initial knowledge before teaching some new content to direct the learning process. (Yang et al., 2021) A good learning design is a learning design that considers the initial abilities of prospective chemistry teacher students. (Van & Tinonas Diaz, 2019b)

At the material collection stage, 12 questions were asked related to the concept of biopolymers. The questions are arranged based on the learning objectives to be achieved on the biopolymer content related to the context of bioplastics. The questions include the definition, classification, benefits, development, impact of bioplastics as applications of biopolymer compounds, and how to design a procedure for making simple bioplastics made from starch. After the test questions are tested, the results of the student's initial ability on the biopolymer content will be analyzed and categorized in stages two and three.

The results of the Initial ability research of students on biopolymer content related to the context of bioplastics have been presented in Table 1. and Table 2. Data analysis begins by scoring each student's answer as a teacher candidate by the answer key that has been developed. After the score is obtained, the score will be grouped on each question with the caption 0= Bad (-); 1= Sufficient (+); 2= Good (++); 3= Very Good (+++). Then the number of scores that have been grouped is converted into percentage data (Table 1.). This grouping aims to make it easier to analyze the Initial ability of students on biopolymer content.

Table 1. Percentage of Student's Initial Ability Each Question

No	Question	Student Initial Ability %			
		-	+	++	+++
1.	Question 1	0	56	33	11
2	Question 2	19	52	26	4
3	Question 3	19	48	26	7
4	Question 4	19	59	22	0
5	Question 5	4	48	48	0
6	Question 6	4	48	44	4
7	Question 7	30	48	22	0
8	Question 8	52	48	0	0
9	Question 9	59	30	11	0
10	Question 10	81	19	0	0
11	Question 11	33	30	37	0
12	Question 12	52	44	4	0
	Entire	31	44	23	2

Ket: (-) = Bad (+) = Fair (++) = Good (+++) = Very Good

The results of data analysis obtained the total percentage of initial abilities in each category. If sorted from the largest, it was identified as a whole that 44% of students had initial abilities with the category of adequate, 31% of students with the category of bad, 23% of students with the category of good, and 2% of students had Initial ability with the category of very good.

The next stage is to analyze the results of the student's initial ability on each question. The analysis of these results aims to identify what learning obstacles students experience. The results of the Initial ability analysis produced very varied answers. This is an important point that supports the fact that it is important to assess initial abilities to find out the variation between students (Hailikari et al., 2008) Based on the results of the analysis of student Initial ability data with a bad category and enough the 12 questions that have been presented, students were identified as experiencing the most learning obstacles in the sub-discussion, including (1) *biodegradable* biopolymer classification(2) the process of decomposing starch (3) the benefits of biopolymers in various fields (4) the benefits of bioplastics for the environment (5) the dilemma of the sustainability issue of bioplastics (6) the function of materials in the manufacture of bioplastics.

The learning obstacles experienced by students in learning biopolymer content through the context of bioplastics are influenced by several factors, including that students do not fully understand basic concepts, such as *the terms biobased* and *biodegradable* so students experience learning barriers when learning biopolymer classification. This is in line with the theory that previous knowledge is a stepping stone for students to continue other topics of discussion. (Van & Tinonas Diaz, 2019b) The second factor is the lack of information about bioplastics among students. This is in line with the results of research that states that bioplastics are still at the *niche* level and bioplastics only have a small market share in Indonesia (Soesanto et al., 2016). Then the third factor is that students do not understand the concept of ESD and the relationship

between bioplastics and sustainable aspects (environmental, economic, and socio-cultural). This is in line with the results of research on the implementation of ESD in Indonesia regarding the achievement of ESD in NTB which is still considered difficult to achieve because there has not been maximum cooperation between local governments, educational institutions, and community elements. (Sutanto, 2017)

Thus, the results of the analysis of learning barriers that have been obtained can be used as a reference in developing didactic situations in the design to be developed (Table 2.)

Table 2. Results of the Planned Didactic Situation Design

No	Question Item	Planned Didactic Situations
1	Classification of *biodegradable biopolymers*	Educators can make efforts by displaying a graph of the 2021 bioplastic production capacity in order to provide students with an overview of biopolymer examples and classifications.
2	The process of decomposition of starch	Educators can display a table of the names of degrading enzymes from several biopolymer compounds, as well as infographics related to the biopolymer decomposition process so that students can describe the biodegradation process of each biopolymer properly and correctly.
3	Benefits of biopolymers in various fields	Educators need to provide some examples of bioplastics in daily life, then educators direct students to group them in the right fields.
4	Benefits of bioplastics for the environment	Educators can direct students to think about bioplastics made from *biobases* can overcome the shortcomings of petroleum-based materials or educators can ask questions related to how examples of environmental problems caused by non-*biodegradable* plastic waste can be overcome by *biodegradable* plastics (Connect with cases of water pollution and soil pollution).
5	The dilemma of bioplastic sustainability issues	Educators can make efforts by displaying a graph of production cost sharing for bioplastic factories (economic aspect) and displaying a graph of bioplastic production capacity for 2021-2026 (socio-cultural aspect), then educators direct students to compare it with the annual production of petrochemical plastics.
6	Function of materials in the manufacture of bioplastics	Educators can make efforts by showing learning videos related to the function of materials in making bioplastics so that students can gain knowledge properly and correctly.

4. CONCLUSION

Based on the results of the data analysis obtained, it can be concluded that overall, as many as 41% of students were identified as having an initial ability to understand of a sufficient category, 33% of students had a bad category, 23% of students with a good category and 3% of students having an Initial ability understanding with a very good category. Students were identified as experiencing learning obstacles in several sub-discussions, namely (1) the classification of *biodegradable biopolymers*, (2) the benefits of biopolymers in various fields, (3) the function of materials in the manufacture of bioplastics, (4) the dilemma of sustainability issues, (5) the benefits of bioplastics for the environment, and, (6) the process of decomposition of starch biopolymers. Based on these findings, several interventions are suitable as a reference in developing didactic designs, such as displaying learning videos related to the manufacture of simple bioplastics, graphs of the development and financing of the annual production of bioplastics, images of bioplastic applications in various fields and infographics related to the decomposition process and sustainability benefits of bioplastics.

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