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The research finding of marine fungi as milkfish feed and its utilization for biotechnology digital magazine

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ABSTRACT

This study aimed to determine the utilization of research results of the selection of marine fungi for milkfish (*Chanos chanos*) feed. The study was conducted in stages, starting with identifying the issues in the learning activities of biotechnology concepts, followed by experiments to identify research methods and products, selecting an adaptation of research findings as the learning source content, and application and development of research findings as learning. The data and information were gathered through an interview grid and a questionnaire, and the findings of the surveys were then analyzed qualitatively. The results of a selection study of marine fungi from Dua Island, Banten, Indonesia as feed for milkfish related to basic competency (KD) 3.10 and 4.10 can be used as learning resources as digital magazines for class XII high school students. Thus, media can help student in learning process.

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1. INTRODUCTION

The development of biology as science is supported by various studies conducted by scientists. The finding of biology research should be used as a learning resource in the schools. Learning resources are anything that can facilitate a person to gain experience in the form of tools, materials, and even events that can be used as a reference for someone to gain knowledge [1]. The use of learning resources is expected to facilitate teachers and students in learning so that the use of relevant learning resources can support student learning outcomes so that they can achieve the expected goals [2]. The utilization of learning resources is influenced by internal and external (environmental) factors. Internal factors that have a dominant influence include the user's enthusiasm, interest, awareness, comfort, and ability. Influential external factors are variations in learning resources, ease of access to learning resources, learning processes, human resources, space, and systems that apply in schools or educational institutions [3].

Learning resources facilitate the learning process and prepare young people to face the 21st century. In the 21st century, challenges and demands will be increasingly complex, marked by the era of revolution 4.0 which is belived to have experienced many changes in term of society, enviroment and health. Therefore, learning is needed that does not only rely on knowledge but skills as an important component in order to adapt [4]. Education is part of efforts to improve the quality of people with complete competencies applied in school learning activities. Thus, 21st century education is expected to create quality human resource in various fields [5].

One of the research results that can be used as a source of learning is a selection of marine fungi from Dua Island, Banten, Indonesia as feed for milkfish (*Chanos chanos*). Research results can be used as learning resources if they meet the requirements, including the learning objectives to be achieved, the quality of learning resources, the availability of media materials, and affordable procurement costs [6]. The content of the results of this study is associated with basic competency (KD) 3.10 and 4.10 on the concept of biotechnology for class XII high school. Accordingly, interviews with teachers and students at several state high schools in Banten Province, Indonesia revealed that research findings had never been used to illustrate biotechnology concepts in a learning resource. In addition, the results of the questionnaire analysis showed that students did not understand biotechnology materials because the learning resources used did not support learning. The learning resources used are considered less attractive, so students are less interested in understanding biotechnology materials. Therefore, digital magazines are proposed as a learning resource for education which is strengthened by the information of the need analysis from teachers and students. They expressed an interest in using digital magazines as a learning resource on the biotechnology concept.

A magazine is a print media to disseminate information to the public [7]. Digital magazine is a print media as a means of disseminating information to people who are experiencing a digitization process [8]. Learning resources in digital magazines are expected to make it easier for teachers and students to achieve the maximum possible learning goals. Digital magazines are preferred because their appearance is considered not monotonous, brief, concise, and complete. Furthermore, digital magazines are equipped with pictures as easy-to-understand representations [9]. Digital magazines can increase students' interest in reading because they have various advantages, e.g. easy to use anytime and anywhere, students get new experiences, and they can provide information for their readers [10]. In line with these results, digital magazines increase students' interest in reading and make it easier for students to understand the material [11]. Based on this, the use of content from research on the selection of marine fungi from Dua Island, Banten as feed for milkfish (*Chanos chanos*) needs to have educational implications as a biology learning resource in the form of digital magazines.

2. RESEARCH METHOD

The research was conducted at the Biology Education Study Program, Faculty of Teacher Training and Education, Sultan Ageng Tirtayasa University, Indonesia and several public senior high schools in Banten Province (SMAN 4 Kota Serang, SMAN 6 Kota Serang, SMAN 1 Kibin and SMAN 1 Pabuaran). The content in the learning resources are facts obtained from the results of research on marine mushroom selection for milkfish (*Chanos chanos*) feed such as information about fish growth parameters and nutritional content in fish feed derived from marine fungi.

There are several stages carried out in this research. Curriculum analysis is the first step to find the link between research findings and biotechnology course material. Curriculum analysis starts from the analysis of KD according to the contents of the research results. Then those competencies were translated into competency achievement indicators (GPA) and then the indicators were reduced to learning objectives as a reference for This study is conducted throughout a number of stages. The first stage in establishing a connection between research findings and biotechnology course content is curriculum analysis. The analysis of the curriculum begins with the examination of the knowledge and KD skills in accordance with the findings of the study. These skills were then converted into GPA, which were then reduced to learning goals as a reference for guiding a learning process.

Analysis of learning resources appropriate to the concept of biotechnology carried out in order to find the suitable learning resources. Learning resources that will be proposed as effective learning resources on the concept of biotechnology are selected based on the results of the needs analysis [12]. Respondents consisted of biology teachers and class XII high school students.

3. RESULTS AND DISCUSSION

Based on the results of the needs analysis of students and teachers, biotechnology concept material is considered material that is difficult to understand. This is inseparable from the supporting facilities for succesfull learning such as learning resources a material which are considered unattractive. Therefore, that students' motivation and interest in learning biotechnology concepts is reduced. The selection of learning resources plays a very important role in determining the success of a lesson because it can help improve learning more effectively and efficiently and provides opportunities to develop students' abilities and potential so that they can achieve predetermined instructional goals. In addition, teachers must be expert in designing and using learning resources according to the needs of students [13]. In this study the selection of learning resource types was based on a needs analysis conducted in four state high schools for students and

teachers and also supported by literature studies. There are several factors that influence students' interest in learning e.g. motivation, talent, learning, learning methods and learning resources used. Utilization of appropriate learning resources will increase student learning interest so as to increase student achievement [14]. The results of the needs analysis for learning resources can bee seen in Figure 1.

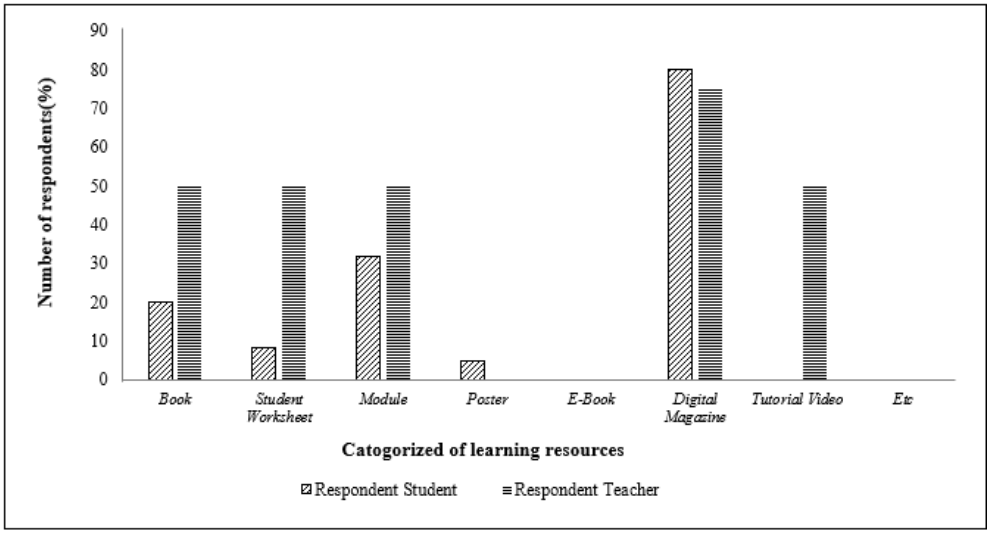


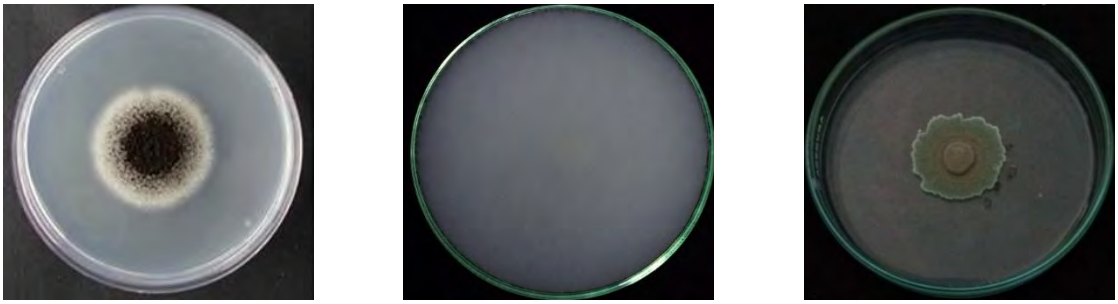
Figure 1. Questionnaire results of the types of learning resources required

Figure 1 shows that about 80% of students and 75% of teachers choose digital magazines as a learning source for the implications of the required research results. The qualities of a magazine as a learning resource that set it apart from other learning resources include its detailed presentation supported by background information, more photographs or photos offered, the cover presented as an attraction, and a magazine can have many rubrics. The use of digital magazines as a learning resource has been associated with academic success and its benefits of speedy communication and access to various resources [15]. Any platform may upload and appealingly display digital magazines. The benefits of digital magazines utilizing anyflip platform include operating without downloading any software and opening them offline after downloading, which helps to reduce paper use periodically. On this platform, digital magazines can be directly accessed by computer or mobile device or downloaded via laptop or computer.

The development of digital magazines can increase learning motivation and new desires and positively influence students' psychology because they are considered more practical to use in learning [16]. The development of learning resources requires a storyboard design as a reference in learning resource development. The developed digital magazine contains components such as the front cover, which includes the magazine title, images related to the concept of biotechnology and the colony of marine fungi, magazine identity (material title, level/semester/class), and the author's name. The back cover contains the logo of the Faculty of Teacher Training and Education, Sultan Ageng Tirtayasa University, a map of the Pulau Dua nature reserve, and milkfish feed. Preface page that contains the title, contents of the preface, and the editorial team. The biotechnology concept's core and essential competencies and learning objectives are displayed on separate pages. The manual user page serves as a guide for using the magazine for readers. Material and sub-material pages contain the rubric's name, big title, sub-headings, and images from the material's content and contents. The magazine also includes a bibliography and glossary page. The author history page is also equipped with an evaluation page. Evaluation is a procedure to determine whether subjects (students) meet predetermined criteria and measures for success in a lesson. Evaluation is used as a basis for deciding what to improve if successful or abandoned if not and looking for causes and solutions for further learning [17].

The results of research related to the utilization of marine fungi from Pulau Dua as a raw material for milkfish feed were analyzed for their use as a source of reference and information for class XII senior high school students in even semester in biology learning. The results of the screening the appropriate isolate of marine fungi from Dua Island, Banten as feed for milkfish (*Chanos chanos*) larvae based on the increasement of absolute length gain of the milkfish. From 25 isolates of marine fungi screened, there was three isolates which showed good result on length gain and increasing the survival rate of milkfish;

Figure 2(a) shows *Aspergillus* sp. 11, Figure 2(b) shows *Cunninghammela echinulata*, and Figure 2(c) shows *Penicillium* sp 4. Milkfish growth is related to the efficient use of feed. If the fish's energy needs are met and there is an excess of energy in the feed, then the rest of the energy will be used for growth. According to Assan *et al*. [18], the quality of fish feed is a factor whicl influence the survival rate of fish.



(a) (b) (c)

Figure 2. The colonies of marine fungi isolates used in the study (a) *Aspergillus* sp. 11, (b) *Cunninghammela echinulata* and (c) *Penicillium* sp. 4

Three isolated were tested on the the nutritional content requirement included levels of protein, fat, carbohydrates, fiber, ash and water which can be seen Table 1. Based on study conducted by Rombenso *et al.* [19] stated that fish nutritional needs include protein, ash, water, carbohydrates, fiber and fat to support fish growth, reproduction and health. Commercial feed that is commonly used is relatively more expensive so it cannot reduce production costs. However, this can be overcome by alternative sources of raw materials that supply fish nutrition. The nutrients in milkfish feed can be supplied from various alternative raw materials. According to Yun *et al*. [20] the use of yeast isolated from the marine ecosystem in feed formulations can increase energy digestibility and fat retention in fish.

Table 1. Nutritional content in fish feed

Treatment	Nutrient content (%)					
	Proteins	Fat	Carbohydrate	Fiber	Ash	Water
Positive control	30±2^{a}	3±0^{c}	54.80±0.5^{a}	4±0.2^{d}	12±0.5^{a}	12±0.4^{a}
Negative control	15.86±0.84^{c}	11±0.5^{b}	42.63±0.58^{b}	21±1^{b}	2.79±0.38^{a}	6.67±0.35^{c}
Cunninghamella echinulata	12.55±0.45^{d}	2.08±0.02^{d}	46.84±0.16^{b}	25.16±0.16^{a}	4.04±0.97^{bc}	9.32±0.28^{b}
Aspergillus sp.11	21.15±0.05^{b}	15.42±0.2^{a}	33.59±1.58^{c}	18.16±0.15^{c}	3.26±0.04^{bc}	8.43±0.38^{b}
Penicillium sp.4	21.4±0.2^{b}	15.77±0.27^{a}	32.56±0.56^{c}	17.51±0.18^{c}	4.34±0.26^{b}	8.42±0.41^{b}

Information: Value is the average result of three repetitions ± standard deviation; Supercript letters indicate significantly different treatments between treatments (F count >0.05)

The information obtained from the research results is adapted to the revised 2013 curriculum. The initial stage in curriculum analysis starts with determining KD according to the research results. Determination of basic competencies is an important part of guiding students to achieve the expected learning outcomes [21]. The basic competence to be achieved in the knowledge domain is KD 3.10, namely understanding the principles of biotechnology that apply bioprocesses in producing new products to improve human welfare in various aspects of life. Basic competencies that contain the realm of skills are found in KD 4.10, that is planning and conducting experiments in the application of conventional biotechnology principles to produce products and evaluating the products produced and the procedures carried out. The results of the research potential analysis of the revised 2013 KD curriculum are listed in Table 2.

Based on the results of the analysis in Table 2 of objects and phenomena supported by facts, research results can be used as a source of information in learning biology in the form of learning resources. The KD in accordance with the results of analysis in the realm of knowledge: i) KD 3.10 Understanding of the principles of biotechnology that apply bioprocesses in producing new products to improve human welfare in various aspects of life and the realm of skills and ii) KD 4.10 Planning and conducting experiments in the application of these principles conventional biotechnology principles to produce products and evaluate the products produced and the procedures carried out. After the basic competencies are adjusted, then become a GPA.

Table 2. Potential analysis of research results on basic competencies in curriculum 2013 revision

The object of research and the phenomena observed	Utilized potential as learning content biology	KD
Marine fungi	1. *Aspergillus* sp.11 and *Penicillium* sp.4 species can increase the levels of protein, fat, ash and water in artificial feed which are useful for the growth and survival of fish 2. *Aspergillus* sp.11 and *Penicillium* sp.4 species can reduce carbohydrate and fiber content so as not to exceed the maximum limit contained in the feed. Carbohydrate and fiber levels that are too high can inhibit the growth and survival of fish. *Cunninghamella echinullata* species can increase carbohydrate levels. Adequate levels of carbohydrates can prevent the use of protein for energy	(KD 3.10) Understanding the principles of biotechnology that apply bioprocesses in producing new products to improve human welfare in various aspects of life
Potential of marine fungi as raw material for milkfish feed	1. *Aspergillus* sp.11, *Penicillium* sp.4 and *Cunninghamella echinulata* are the treatments with the highest length gain and survival results which can be used as artificial feed for milkfish 2. Based on the results of proximate analysis, the nutritional content contained in the artificial feed *Aspergillus* sp.11, *Penicillium* sp.4 and *Cunninghamella echinulata* can meet the nutritional needs of milkfish	(KD 4.10) Planning and conducting experiments in the application of conventional biotechnology principles to produce products and evaluate the products produced and the procedures carried out

The teaching and learning process must be prepared as well as possible to achieve competence in accordance with the established curriculum. The GPA has a role as a marker of achieving basic competence as indicated by measurable student behavior including attitudes, knowledge, and skills [22]. The indicators that are developed must reach a minimum level of a basic competency and may exceed it to suit the needs of students at the time of the final assessment [23]. The GPA is formulated using operational verbs which are required by the teacher when compiling the syllabus and lesson plans. The operational verb is divided into several domains, namely the cognitive domain (ability to think/reason), the affective domain (character/attitude) and the psychomotor domain (skills) [24]. After the indicators are set, they are then lowered into learning objectives taking into account the conditions of the students and the facilities used GPA and learning objectives are listed in Table 3.

Table 3. GPA and learning objectives from KD 3.10 and 4.10 in the revised 2013 curriculum

KD	GPA	Learning objectives
(KD 3.10) Understand the principles of biotechnology that apply bioprocesses in producing new products to improve human welfare in various aspects of life	1. Gives a definition of biotechnology (C1) 2. Explain the types of biotechnology (C2) 3. Analyzing the role of microbes in biotechnology in everyday life (C4) 4. Analyzing the impact of using biotechnology products for life (C4)	1. After learning, students can dig up information about biotechnology and its development through literature studies 2. After learning, students can analyze various conventional and modern biotechnology products through literature studies 3. After learning, students can analyze the role of microbes in biotechnology in everyday life. 4. After learning, students can describe the impact of using biotechnology products on life
(KD 4.10) Planning and conducting experiments in the application of conventional biotechnology principles to produce products and evaluate the products produced and the procedures carried out	1. Designing the manufacture of conventional biotechnology products (P2) 2. Making conventional biotechnology products according to plan (P3)	1. After learning, students can design the creation of conventional biotechnology products 2. After learning, students can make conventional biotechnology products according to plan

Competency achievement indicator or CAI in KD. 3.10 listed in Table 3 contains the cognitive domain which is developed into four indicators, namely giving definitions (C1), explaining (C2) and analyzing (C4). The levels of thinking in the cognitive domain are grouped into two, namely lower-order thinking skills (LOTS) containing C1 to C3 and higher-order thinking skills (HOTS) containing C4 to C6 [25]. Based on this, the indicators for aspects C1 and C2 in KD 3.10 are classified into low-order thinking skills or LOTS. Low-order thinking skills are generally only focused on the ability to remember, collect, and explain back information obtained by students [26]. C4 aspect indicators are classified into HOTS. Cognitive domain C4 is an indicator that demands students' analytical skills which are embodied in a learning activity.

In various subjects students are required to have the ability to analyze in order to be able to distinguish facts and opinions and be able to draw conclusions from information to achieve higher-order thinking skills [27].

The ability to think at a high level should be mastered by human resources (HR) in the 21st century. The rapid development of science and technology produces more complex challenges and problems so that the younger generation needs provisions to adapt [28]. Learning that is oriented towards higher order thinking skills is expected to improve the quality of students achieving various competencies, namely critical, creative and innovative thinking, communication skills and cooperative abilities [29].

The GPA in KD. 4.10 listed in Table 2 contains the psychomotor domain which is developed into two indicators, namely designing (P2) and making (P2). The psychomotor domain (skills) needs to be developed to improve student quality [30]. The psychomotor domain relates to learning outcomes through skills to measure understanding comprehensively. Students are required to be able to apply the theory obtained through learning activities into real actualization [31]. The results are in accordance with the contents of the biology syllabus development. Therefore, the results of research on the utilization of marine fungi as a raw material for milkfish feed can be used as learning content on the concept of biotechnology listed in KD 3.10 which contains the realm of knowledge and KD 4.10 which contains the realm of skills.

4. CONCLUSION

Based on the results of the analysis of the revised 2013 curriculum on research content and analysis of the needs of learning resources that are appropriate to the concept of biotechnology, the results of the selection of marine fungi from Dua Island, Banten as feed for milkfish (*Chanos chanos*) can be used as a learning resource. The learning resource chosen was in the form of digital magazines with the highest selection percentage. Digital magazines are uploaded on the any flip platform which is expected to make it easier for teachers and students in learning.

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